US Army Corps
of Engineers
Louisville District

Solicitation for

Aviation Support Facility
Ft. Eustis, Virginia

19 October 1998

SFB DACA27-98-B-0038

THIS PROCUREMENT
IS 100% SET ASIDE
FOR SMALL BUSINESS

USACE CONSTRUCTION CONTRACT FORMAT

DIVISION	SECTION	TITLE
	00010	Solicitation/Contract Form (1442) Bid Schedule
	00105	Instruction to Offers
	00605	Representations and Certifications
	00700	Contract Clauses
	00800	Special Contract Requirements
01000		Division 1, General Requirements
02000 thru 16999		Division 2-16, Technical Provisions

INDEX

DIVISION 1 – GENERAL REQUIREMENTS

00010 Solicitation/Contract Form
00105 Instruction for Bidders
00605 Rep, Cert, and Other Statements of Bidders
00700 Contract Clauses
00800 Special Contract Requirements
01005 Project Work Requirements and Restrictions
01055 Soil Boring Data
01090 Sources for Reference Publications
01111 Safety and Health Requirements
01200 Project Meetings
01300 Submittal Procedures
01310 Project Schedule
01415 Metric Measurements
01440 Contractor Quality Control
01451 Testing for Mechanical and Electrical Systems
01500 Temporary Construction Facilities
01560 Environmental Protection (Project Site)
01700 As-built Record Drawings and Shop Drawings

DIVISION 2 SITEWORK

02050 Demolition
02221 Excavation, Filling and Backfilling for Buildings
02225 Earthwork for Roadways, Railroads and Airfields
02230 Clearing and Grubbing
02285 Soil Treatment for Subterranean Termite Control
02316 Excavation, Trenching and Backfilling for Utilities Systems
02511 Concrete Sidewalks and Curbs and Gutters
02551 Bituminous Paving for Roads, Streets, and Open Storage Areas
02580 Pavement Markings
02620 Subdrainage System
02660 Water Lines
02714 Drainage Layer
02720 Storm Drainage System
02721 Subbase Courses
02722 Graded, Crushed Aggregate Base Course
02730 Sanitary Sewers
02732 Force Mains and Inverted Siphons, Sewers
02748 Bituminous Tack and Prime Coats
02754 Concrete Pavements for Small Projects
02760 Field Molded Sealants for Sealing Joints in Rigid Pavements
02935 Turf

DIVISION 3 - CONCRETE

03100 Structural Concrete Formwork
03200 Concrete Reinforcement
03250 Expansion Joints, Contraction Joints, and Waterstops
03300 Cast In Place Structural Concrete

DIVISION 4 MASONRY

04200 Masonry

DIVISION 5 METALS

05055 Welding, Structural
05061 Ultrasonic Inspection of Weldments
05120 Structural Steel
05210 Steel Joists
05300 Steel Decking
05400 Cold Formed Metal Framing
05500 Miscellaneous Metal

DIVISION 6 WOOD AND PLASTIC

06114 Wood blocking and Curbing
06200 Finish Carpentry
06650 Solid polymer Fabrications

DIVISION 7 THERMAL AND MOISTURE PROTECTION

07160 Bituminous Dampproofing
07191 Vapor Retarders
07212 Board Insulation
07213 Batt Insulation
07270 Firestopping
07416 Standing Seam Metal Roof System
07465 Preformed Metal Wall Panels
07620 Sheet Metal Flashing and Trim
07900 Joint Sealers

DIVISION 8 DOORS AND WINDOWS

08111 Standing Steel Doors
08112 Standard Steel Frames
08211 Flush Wood Doors
08318 Security Vault Door
08331 Overhead Coiling Doors
08332 Overhead Counter Shutter
08342 Steel Sliding Hangar Doors
08410 Aluminum Entrances and Stormfronts
08520 Aluminum Windows
08710 Door Hardware
08800 Glazing
08840 Translucent Wall Panels

DIVISION 9 FINISHES

09111 Metal Stud Framing System
09260 Gypsum Board Systems
09306 Floor Tile
09307 Wall Tile
09511 Suspended Acoustical Ceilings
09650 Resilient Flooring
09690 Carpet Tile
09706 Industrial Fluid Applied Ceilings
09900 Painting

DIVISION 10 SPECIALITIES

10105 Visual Display Boards
10160 Metal Toilet Compartments
10211 Metal Wall Louvers
10440 Interior Signage

10508 Metal Wardrobe Lockers
10522 Fire Extinguisher, Cabinets and Accessories
10605 Wire Mesh Partitions
10800 Toilet and Bath Accessories

DIVISION 11 EQUIPMENT

11134 Projection Screens
11165 Dock Bumpers
11306 Packaged Lift Stations
11311 Parallel Plate, Gravity Oil – Water Separator

DIVISION 12 FURNISHINGS

12512 Horizontal Louver Blinds

DIVISION 13 SPECIAL CONSTRUCTION

13080 Seismic Protection for Mechanical, Electrical Equipment
13120 Standard Metal Building Systems

DIVISION 14 CONVEYING SYSTEMS

14630 Overhead Electric Cranes

DIVISION 15 MECHANICAL

05010 Basic Mechanical Requirements
15121 Piping Expansion Compensation
15140 Supports and Anchors
15170 Motors
15190 Mechanical Identification
15245 Vibration Insulation
15260 Piping Insulation
15280 Equipment Insulation
15290 Ductwork Insulation
15330 Wet Pipe Sprinkler System, Fire Protection
15355 Aqueous Film – Forming Foam (AFFF) Fire Protection System
15410 Plumbing Piping
15430 Plumbing Specialities
15440 Plumbing Fixtures
15450 Plumbing Equipment
15481 Compressed Air System
15510 Hydronic Piping
15515 Hydronic Specialities
15540 HVAC Pumps
15545 Chemical Water Treatment
15558 Finned Water Tube Boilers
15575 Breechings, Chimneys and Stacks
15624 Indirect Fired Air Units
15671 Air Cooled Condensing Units
15681 Packaged Water Chillers
15784 Unitary Air Conditioners
15690 Air Coils
15835 Terminal Heat Transfer Units

15855 Air Handling Units with Coils
15860 Centrifugal Fans
15865 Axial Fans
15885 Air Cleaning Devices
15890 Ductwork
15910 Ductwork Accessories
15940 Air Outlets and Inlets
15951 Direct Digital Control for HVAC
15980 Instrumentation
15990 Testing, Adjusting and Balancing

DIVISION 16 ELECTRICAL

16101 General Provisions – Electrical
16111 Conduit
16114 Cable Trays
16117 Manholes
16118 Utility Pits
16123 Building Wire and Cable
16130 Boxes
16140 Wiring Devices
16160 Cabinets and Enclosures
16170 Grounding and Bonding
16180 Equipment Wiring Systems
16190 Supporting Devices
16195 Electrical Identification
16268 400 Hertz (Hz) Solid State Frequency Converter
16375 Electrical Distribution System, Underground
16441 Enclosed Switches
16461 Dry Type Transformers
16470 Panelboards
16477 Fuses
16481 Enclosed Motor Controllers
16485 Contactors
16510 Lighting
16528 Exterior Lighting
16670 Lightning Protection System
16721 Fire Alarm Systems
16726 Vault Intrusion Detection System
16741 Telephone System, Inside Plant
16742 Telephone System, Outside Plant

OMB APPROVAL NO. 2700-0042

SOLICITATION, OFFER, AND AWARD (Construction, Alteration, or Repair)	1. SOLICITATION NO.	2. TYPE OF SOLICITATION	3. DATE ISSUED	PAGE OF PAGES
	DACA27-98-B-0038	☒ SEALED BID (SFB) ☐ NEGOTIATED	19 Oct. 1998	1 of 5

IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.

7. ISSUED BY CODE	8. ADDRESS OFFER TO
U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place Louisville, Kentucky 40202-2230	U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place, Room 821 Louisville, Kentucky 40202-2230

9. FOR INFORMATION CALL:	A. NAME	B. TELEPHONE NO. *(Include area code)* ***(NO COLLECT CALLS)***
	See Instructions	See Instruction

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder."

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS *(Title, identifying no., date):*

AVIATION SUPPORT FACILITY, FORT EUSTIS, VA.

This project consist of the construction of a 4800 sm Aviation Support Facility to provide approximately 2400 sm of hangar space and associated shops and administrative areas; construction will be structural steel and masonry, with metal roof and wall panels. Also included are site utilities, paving, unheated storage, wash rack and landscaping.

The estimated cost range of this project is from $5,000,000.00 to $10,000,000.00.

BID MODIFICATIONS RECEIVED BY FACSIMILE OR TELETYPE WILL NOT BE CONSIDERED.

DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) FAR 52.211-14: This is a rated order certified for national defense use, and the Contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR 700), PRIORITY RATING: DO-C2

11. The Contractor shall begin performance within _10_ calendar days and complete it within _**_ calendar days after receiving ☐ award, ☒ notice to proceed. This performance period is ☒ mandatory, ☐ negotiable. *(See **Section 00800, Para 1.)*

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS?	12B. CALENDAR DAYS
☒ YES ☐ NO	10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and _2__ copies to perform the work required are due at the place specified in Item 8 by **2:00 p.m.** local time **18 November 1998**. If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee ☒ is, ☐ is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than __60___ calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

OFFER *(Must be fully completed by offeror)*

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
DUNS #	16. REMITTANCE ADDRESS *(Include only if different than Item 14)* TIN #
CODE FACILITY CODE	

17. The offeror agrees to perform the work at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government within __60___ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.*

AMOUNTS	Bidders shall show his prices on the Bid Schedule of this section.

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS

The offeror acknowledges receipt of amendments to the solicitation -- give number and date of each

AMENDMENT NO.										
DATE										

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20B. SIGNATURE	20C. OFFER DATE

AWARD *(To be completed by Government)*

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA	
24. SUBMIT INVOICES TO ADDRESS SHOWN IN *(4 copies unless otherwise specified) Will be identified in Delegation letters.*	ITEM: Sec 00105 Para. 30	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C. 2304(c)( ) ☐ 41 U.S.C. 253(c)( )
26. ADMINISTERED BY CODE U.S. Army Engineer District, Louisville Corps of Engineers, P.O. Box 59 Louisville, KY 40201-0059		27. PAYMENT WILL BE MADE BY USACE Finance Ctr. (UFC) 7800 Third Avenue EFT:T Millington, TN 38054-5005

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return ____ copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration slated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications or incorporated by reference in or attached to this contract.		☐ 29. AWARD *(Contractor is not required to sign this document.)* Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.	
30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*		31A. NAME OF CONTRACTING OFFICER *(Type or print)*	
30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY	31C. AWARD DATE

ALL BIDDERS READ THE FOLLOWING INSTRUCTIONS

1. Each bidder shall, upon request of the Contracting Officer, furnish a list of the plant available to the bidder and proposed for use of the work.

2. Bidders are cautioned that drawings may not be reproduced to exact scale. All drawings, whether full size or reduced, should be checked for potential discrepancies, dimensions and scales should be verified and all drawings compared.

3. Bidders are required to acknowledge receipt of all amendments to this solicitation on Standard Form 1442 in the space provided, by completing Blocks 8 and 15 of the Amendment Form (SF 30), by separate letter, or by telegram prior to opening of bids. Failure to acknowledge all amendments may cause rejection of the bid/proposal.

NOTE: The Louisville District Office does not have it's own teletype. The bidder must insure that acknowledgment of any of any amendments by telegram will be physically delivered (telephone delivery is not acceptable) and received by the Government prior to the time set for opening of bids.

NEITHER FACSIMILE NOR TELEGRAPHIC BIDS ARE AUTHORIZED!!

CAUTION TO BIDDERS

BEFORE SIGNING AND MAILING THIS BID, PLEASE TAKE NOTE OF THE FOLLOWING, AS FAILURE TO PERFORM ANY ONE OF THESE ACTIONS MAY CAUSE YOUR BID TO BE REJECTED.

1. **AMENDMENTS**. Have you acknowledge receipt of ALL amendments? If in doubt as to the number of amendments issued, please contact our office.

2. **AMENDED BID PAGES**. If any of the amendments furnished amended bid pages, the amended bid pages must be used for preparation of your bid.

3. **LATE BIDS**. Please refer to the Instructions section contained in this package.

4. **BID GUARANTEE**. If bid guarantee is required for this project, sufficient bid guarantee in proper form must be furnished with your bid for construction projects exceeding $100,000.

5. **MISTAKE IN BID**. Have you reviewed your bid prices for possible errors in calculations or work left out?

6. **FAX MODIFICATIONS OF BIDS**. We do not permit modifications of bids by fax.

BID SCHEDULE

CONTINUATION SHEET	REFERENCE NO. DOCUMENT BEING CONTINUED DACA27-98-B-0038	PAGE 5 of 5

NAME OF OFFEROR OR CONTRACTOR

ITEM NO.	SUPPLIES/SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
	Aviation Support Facility, Fort Eustis, VA.				
1	Aviation Support Building to the 5” foot line.	1		L/S	$_____
2	Enclosed Storage Building to the 5” foot line.	1		L/S	$_____
3	Sitework	1		L/S	$_____
	TOTAL BASE BID				$_____
	Special Bid Conditions. If a modification to a bid based on unit prices is submitted, which provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price in the bid schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.				

OPTIONAL FORM 336 (4-86)
Sponsored by GSA
FAR (48 CFR) 53 110

24 Sep 1998

SECTION 00105

INSTRUCTIONS FOR SEALED BID CONTRACTS

2 Jan 96
1. SOLICITATION DEFINITIONS - SEALED BIDDING - (July 1987) FAR 52.214-1.

"Government" means United States Government. "Offer" means "bid" in sealed bidding. "Solicitation" means an invitation for bids in sealed bidding.

2. AMENDMENTS TO INVITATIONS FOR BIDS (DEC 1989) FAR 52.214-3.

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, 3) by letter or telegram, or (4) by facsimile, if facsimile bids are authorized in the solicitation. The Government must receive the acknowledgment by the time and at the place specified for receipt of bids.

3. FALSE STATEMENTS IN BIDS (APR 1984) FAR 52.214-4.

Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

20 March 1997
4. SUBMISSION OF BIDS (MAR 1997) FAR 52.214-5 (Para. a-e only).

(a) Bids and bid modifications shall be submitted in sealed envelopes or packages, (unless submitted by electronic means).

(1) Addressed to: U.S. Army Engineer District, Louisville
600 Dr. Martin Luther King, Jr. Place
Room 821
Louisville, Kentucky 40202-2230

(2) Showing the time specified for receipt, the solicitation number, and the name and address of the bidder.

(b) Bidders using commercial carrier services shall ensure that the bid is addressed and marked on the outermost envelope or wrapper as prescribed in subparagraphs (a)(1) and (2) of this provision when delivered to the office specified in the solicitation.

(c) Telegraphic bids will not be considered unless authorized by the solicitation; however, bids may be modified or withdrawn by written or telegraphic notice.

(d) Facsimile bids, modifications, or withdrawals will not be considered unless authorized by the solicitation.

(e) Bids submitted by electronic commerce shall be considered only if the electronic commerce method was specifically stipulated or permitted by the solicitation.

(f) Hand-carried bids shall be deposited in the depository located in Room 821, Federal Building, 600 Dr. Martin Luther King, Jr. Place, Louisville, Kentucky.

(g) Express mail bids shall be addressed as shown in Paragraph (a) (1) above, ATTN: CEORLCT/Hitner.

5. EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984) FAR 52.214-6.

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

20 March 1997
6. LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (MAY 1997) FAR 52.214-7.

(a) Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and it--

(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for the receipt of bids (e.g., a bid submitted in response to a solicitation requiring receipt of bids by the 20th of the month must have been mailed by the 15th); or

(2) Was sent by mail (or telegram or facsimile, if authorized) or hand-carried (including delivery by a commercial carrier) if it is determined by the Government that the late receipt was due primarily to Government mishandling after receipt at the Government installation;

(3) Was sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee, not later than 5:00 P.M. at the place of mailing two working days prior to the date specified for receipt of bids. The term "working days" excludes weekends and U.S. Federal holidays; or

(4) Was transmitted through an electronic commerce method authorized by the solicitation and was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of bids.

(b) Any modification or withdrawal of a bid is subject to the same conditions as in paragraph (a) of this provision.

(c) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark both on the envelope or wrapper and on the original receipt from the U.S. or Canadian Postal Service. Both postmarks must show a legible date or the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(d) The only acceptable evidence to establish the time of receipt at the Government installation is the time/date stamp of that installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.

(e) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and the postmark on the envelope or wrapper and on the original receipt from the U.S. Postal Service. "Postmark" has the same meaning as defined in paragraph (c) of this provision, excluding postmarks of the Canadian Postal Service. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(f) Notwithstanding paragraph (a) of this provision, a late modification of an otherwise successful bid that makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

(g) Bids may be withdrawn by written notice or telegram (including mailgram) received at any time before the exact time set for receipt of bids. If the solicitation authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids subject to the conditions specified in the provision entitled “Facsimile Bids.” A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identify of the person requesting withdrawal is established and the person signs a receipt for the bid.

(h) If an emergency or unanticipated event interrupts normal Government processes so as to cause postponement of the scheduled bid opening, and urgent Government requirements preclude amendment of the solicitation or other notice of an extension of the opening date, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

7. PREPARATION OF BIDS - CONSTRUCTION (APR 1984) FAR 52.214-18.

(a) Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a bid must initial each erasure or change appearing on any bid form.

(b) The bid form may require bidders to submit prices for one or more items on various bases, including -

(1) Lump sum bidding;
(2) Alternate prices;
(3) Units of construction; or
(4) Any combination of subparagraphs (1) through (3) above.

(c) If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

(d) Alternate bids will not be considered unless this solicitation authorizes their submission.

1 Aug 96
8. SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991) FAR 52.214-34

Offers submitted in response to this solicitation shall be in the English language. Offers received in other than English shall be rejected.

1 Aug 96
9. SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991) FAR 52.214-35

Offers submitted in response to this solicitation shall be in terms of U.S. dollars. Offers received in other than U.S. dollars shall be rejected.

10. BIDDER'S QUALIFICATIONS.

Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work. The successful bidders will be required to submit his Workman's Compensation Experience Modification Rate (EMR) for the previous 3 years.

11. NOT USED.

28 March 1998
12. BID GUARANTEE (SEP 1996) FARS 52.228-1 (Para. (a) - (e) only).

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, such as a bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.

(c) The amount of the bid guarantee shall be 20 percent of the bid price or $3,000,000, whichever is less.

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.

(e) In the event the contract is terminated for default, the Bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(f) The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents. Bid bonds are not required for projects under $100,000.

(g) Individual Sureties. See Paragraph 15.

20 March 1997
13. PERFORMANCE AND PAYMENT BONDS. After the prescribed forms are presented to the bidder to whom award is made for signature, a written contract on the form prescribed by the specifications shall be executed and two bonds, each with good and sufficient surety or sureties acceptable to the Government shall be furnished: a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A). The penal sums of such bonds will be as follows:

(a) Performance Bond. The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price.

(b) Payment Bond.

(1) When the contract price is $1,000,000 or less, the penal sum will be fifty percent (50%) of the contract price.

(2) When the contract price is in excess of $1,000,000 but not more than $5,000,000, the penal sum shall be forty percent (40%) of the contract price.

(3) When the contract price is more than $5,000,000 the penal sum shall be $2,500,000.

(c) For rules covering the use of individual sureties see Paragraph 15. Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of contract performance.

14. NOT USED.

15. RULES FOR USE OF INDIVIDUAL SURETIES.

(a) One individual surety is adequate support for a bond, provided the unencumbered value of the assets pledged by that individual surety equal or exceed the amount of the bond. An offeror may submit up to three individual sureties for each bond, in which case the pledged assets when combined must equal or exceed the penal amount of the bond. Each individual surety must accept both joint and several liability to the extent of the penal amount of the bond.

(b) An individual surety may be accepted only if a security interest in acceptable assets is provided to the Government by the individual surety. The security interest shall be furnished with the bond, and may be provided by one or a combination of the following methods:

(1) An escrow account with a federally insured financial institution in the name of the contracting agency.

(2) A lien on real property, subject to restrictions contained herein.

(c) Acceptable assets include:

(1) Cash or certificates of deposit, or other cash equivalents with a federally insured financial institution;

(2) United States Government securities at market value;

(3) Stocks and bonds actively traded on a national U.S. security exchange with certificates issued in the name of the individual surety (these assets will be accepted at 90 percent of their 52 week low, as reflected at the time of submission of the bond);

(4) Real property owned in fee simple by the surety without any form of concurrent ownership (these assets will be accepted at 100 percent of the most current tax assessment value exclusive of encumbrances or 75 percent of the properties' unencumbered market value provided a current appraisal is furnished);

(5) Irrevocable letters of credit (ILC) issued by a federally insured financial institution in the name of the contracting agency and which identify the agency and solicitation or contract number for which the ILC is provided.

(d) Unacceptable assets include but are not limited to:

(1) Notes or accounts receivable;

(2) Foreign securities;

(3) Real property as follows:

a. Real property located outside the United States, its territories, or possessions.

b. Real property which is a principal residence of the surety.

c. Real property owned concurrently regardless of the form of co-tenancy except where all co-tenants agree to act jointly.

d. Life estates, leasehold estates, or future interests in real property.

(4) Personal property such as jewelry, furs, antiques;

(5) Stocks and bonds of the individual surety in a controlled, affiliated, or closely held concern of the Offeror/Contractor;

(6) Corporate assets (e.g., plant and equipment);

(7) Speculative assets (e.g., mineral rights);

(8) Letters of credit, except as provided in subparagraph c(5) above.

(e) With respect to the acceptance of real property, the individual surety shall provide:

(1) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice;

(2) Evidence of the amount due under any encumbrance shown in the evidence of title;

(3) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice.

(4) Failure to provide evidence that the lien has been properly recorded will render the offeror nonresponsible.

(f) An individual may be excluded from acting as individual surety on bonds for any of the following causes:

(1) Failure to fulfill the obligations under any bond.

(2) Failure to disclose all bond obligations.

(3) Misrepresentation of the value of available assets or outstanding liabilities.

(4) Any false or misleading statement, signature or representation on a bond or affidavit of individual suretyship.

(5) Any other cause affecting responsibility as a surety of such serious and compelling nature as may be determined to warrant exclusion.

An individual surety excluded pursuant to this subsection shall be included on the list entitled "Parties Excluded from Procurement Programs."

(g) Any bidder or offeror should carefully review these requirements which are set forth in Section 28 of the Federal Acquisition Regulations (FAR).

20 March 1997
16. SITE VISIT FAR (APR 1984) 52.237-1.

Offerors or quoters are urged and expected to inspect the site where services are to be performed and to satisfy themselves regarding all general and local conditions that may affect the cost of contract performance, to the extent that the information is reasonably obtainable. In no event shall failure to inspect the site constitute grounds for a claim after contract award. Site visits may be arranged during normal duty hours by contacting:

Daryl Merryman
Building 1407 (public works building)
P.O Drawer B
Fort Eustis, VA
Tele: (757) 878-5217

24 Sep 1998
17. REQUESTS FOR INFORMATION. Telephone inquiries relating to this procurement should be directed to the Louisville District, Corps of Engineers, as listed below: ORAL EXPLANATIONS OR INSTRUCTIONS GIVEN BEFORE THE AWARD OF A CONTRACT WILL NOT BE BINDING. SEE PARAGRAPH 5: "EXPLANATION TO PROSPECTIVE BIDDERS" FOR PROPER PROCEDURES.

Procurement of Plans
& Specifications--Denise Gill.....502/582-6544
Prospective Bidders may find the planholders list on the Internet at
http://www.orl.usace.army.mil/ct_pages.htm

Technical Questions on Plans
& Specifications—Harrison Fox. P.E.....502/582-6909

18. LOCATION OF BID OPENING. Directions and map to the bid opening address are attached at the end of this section.

24 Sep 1998
19. AVAILABILITY OF SPECIFICATIONS LISTED THE IN GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS, FPMR Part 101-29 (AUG 1998) FAR 52.211-1

(a) The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29, and copies of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained for a fee by submitting request to—

GSA Federal Supply Service
Specifications Section, Suite 8100
470 East L'Enfant Plaza, SW
Washington, DC 20407, Telephone (202) 619-8925,
Facsimile (202) 619-8978

(b) If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitations, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

4 August 1998

20. AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) AND DESCRIPTIONS LISTED IN THE ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST, DOD 5010.12-L (AUG 1998) FAR 52.211-2

(a) Copies of specifications, standards, and data item descriptions cited in this solicitation may be obtained for a fee by submitting a request to the—

Department of Defense Single Stock Point (DoDSSP)
Building 4, Section D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Telephone (215) 697-2667/2179
Facsimile (215) 697-1462

(b) Order forms, pricing information, and customer support information may be obtained—

(1) By telephone (215) 697-2667/2179; or

(2) Through the DoDSSP Internet site at http://www.dodssp.daps.mil.

20 March 1997
21. AVAILABILITY OF SPECIFICATIONS AND STANDARDS NOT LISTED IN DODISS, DATA ITEM DESCRIPTIONS NOT LISTED IN DOD 5010.12-L, AND PLANS, DRAWINGS, AND OTHER PERTINENT DOCUMENTS (DEC 1991) DFARS 252.211-7001

Offerors may obtain the specifications, standards, plans, drawings, data item descriptions, and other pertinent documents cited in this solicitation by submitting a request to:

Technical Point of Contact stated in Paragraph 17.

Include the number of the solicitation and the title and number of the specification, standard, plan, drawings, or other pertinent document.

20 March 1997
(1) 22. NOTICE OF TOTAL SMALL BUSINESS SET-ASIDE (JUL 1996) FAR 52.219-6.

(a) Definition. “Small business concern,” as used in this clause, means a concern including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the size standards in this solicitation.

(b) General.

(1) Offers are solicited only from small business concerns. Offers received from concerns that are not small business concerns shall be considered nonresponsive and will be rejected.

(2) Any award resulting from this solicitation will be made to a small business concern.

(c) Agreement. A small business concern submitting an offer in its own name agrees to furnish, in performing the contract, only end items manufactured or produced by small business concerns in the United States. The term “United States” includes its territories and possessions, the Commonwealth of Puerto Rico, the trust territory of the Pacific Islands, and the District of Columbia. If this procurement is processed under simplified acquisition procedures and the total amount of this contract does not exceed $25,000, a small business concern may furnish the product of any domestic form. This paragraph does not apply in connection with construction or service contracts.

23. INDUSTRY SMALL BUSINESS SIZE STANDARDS (NOV 1988) FAR 19.102.

23.1 General.

(a) The SBA establishes small business size standards on an industry-by-industry basis. These size standards are also set forth in SBA's regulations at 13 CFR 121.

(b) Small business size standards are applied by--

(1) Classifying the product or service being acquired in the industry whose definition, as found in the Standard Industrial Classification (SIC) Manual, best describes the principal nature of the product or service being acquired.

(2) Identifying the size standard SBA established for that industry; and

(3) Specifying the size standard in the solicitation, so that offerors can appropriately represent themselves as small or large.

(c) For size standard purposes, a product or service shall be classified in only one industry, whose definition best describes the principal nature of the product or service being acquired even though for other purposes it could be classified in more than one.

(d) When acquiring a product or service that could be classified in two or more industries with different size standards, contracting officers shall apply the size standard for the industry accounting for the greatest percentage of the contract price.

(e) If a solicitation calls for more than one item and allows offers to be submitted on any or all of the items, an offeror must meet the size standard for each item it offers to furnish. If a solicitation calling for more than one item requires offers on all or none of the items, an offeror may qualify as a small business meeting the size standard for the item accounting for the greatest percentage of the total contract price.

(f) Any concern which submits a bid or offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is deemed to be a small business when--

(1) In the case of Government acquisitions set-aside for small businesses, such nonmanufacturer must furnish in the performance of the contract the product of a small business manufacturer or producer, which end product must be manufactured or produced in the United States. The term "nonmanufacturer" includes a concern which can manufacture or produce the product referred to in the specific acquisition but does not do so in connection with that acquisition. For size determination purposes there can be only one manufacturer of the end item being procured. The manufacturer of the end item being acquired is the concern which, with its own forces, transforms inorganic or organic substances including raw materials and/or miscellaneous parts or components into such end item. Whether a bidder on a particular acquisition is the manufacturer or a nonmanufacturer for the purpose of a size determination need not be consistent with whether such concern is or is not a manufacturer for the purpose of the Walsh-Healey Act.

(2) A concern which packages items and packages them into a kit is considered to be a nonmanufacturer small business and can qualify as such for a given acquisition if it meets the size qualifications of a small nonmanufacturer for acquisition, and if more than 50 percent of the total value of the kit and its contents is accounted for by items

manufactured by small business.

(3) If the acquisition is subject to and is actually procured under "small purchase procedures," such nonmanufacturer may furnish any domestically produced or manufactured product.

(4) For the purpose of receiving a Certificate of Competency on an unrestricted acquisition, a small business nonmanufacturer may furnish any domestically produced or manufactured product. The applicable size standard shall be that of the wholesale industry of the item being acquired.

23.2 The industry size standards are set forth in the following table. The table column labeled "SIC" follows the standard industrial classification code as published by the Government in the Standard Industrial Classification Manual. The Manual is intended to cover the entire field of economic activities. It classifies and defines activities by industry categories and is the source used by SBA as a guide in defining industries for size standards. The number of employees or annual receipts indicates the maximum allowed for a concern, including its affiliates, to be considered small.

23.3 Size standards for construction and special trades.

A concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed $17 million. However, if 75 percent or more of the work (in terms of dollar value) called for by the contract is classified in one of the industries, subindustries, or classes of products listed in this paragraph, the concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed the size standard for that industry, subindustry, or class of products. (See Division C, "Contract Construction," of the SIC Manual).

Classification Code	Industry, Subindustry, or Class of Products	Size Standard*
	MAJOR GROUP 15--BUILDING CONSTRUCTION--GENERAL CONTRACTORS AND OPERATIVE BUILDERS	
1521	General Contractors--Single-Family House	$17.0
1522	General Contractors--Residential Buildings, Other Than Single-Family	17.0
1531	Operative Builders	17.0
1541	General Contractors--Industrial Buildings and Warehouses	17.0
1542	General Contractors--Nonresidential Buildings Other Than Industrial Buildings and Warehouse	17.0
	MAJOR GROUP 16--CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION--GENERAL CONTRACTORS	
1611	Highway and Street Construction, Except Elevated Highway	17.0
1622	Bridge, Tunnel, and Elevated Highway Construction	17.0
1623	Water, Sewer, Pipe Line, Communication and Power Line Construction	17.0
1629	Heavy Construction, Except Dredging N.E.C.	17.0
1629	Dredging and Surface Cleanup Activities	13.5
	MAJOR GROUP 17--CONSTRUCTION--SPECIAL TRADE CONTRACTORS	
1711	Plumbing, heating (except electric), and air conditioning	$7
1721	Painting, paperhanging, and decorating	7

1731	Electrical Work	7
1741	Masonry, stone setting, and other stonework	7
1742	Plastering, drywall, acoustical and insulation work	7
1743	Terrazzo, tile, marble, and mosaic work	7
1751	Carpentering and flooring	7
1752	Floor laying and other floorwork, not elsewhere classified	7
1761	Roofing and sheet metal work	7
1771	Concrete work	7
1781	Water well drilling	7
1791	Structural steel erection	7
1793	Glass and glazing work	7
1794	Excavating and foundation work	7
1795	Wrecking and demolition work	7
1796	Installation or erection of building equipment, not elsewhere classified	7
1799	Special trade contractors, not elsewhere classified	7

* (Average Annual Receipts) (Millions)

24. NOT USED.

2 Jan 96
25. ARITHMETIC DISCREPANCIES EFARS 52.214-5000.

(a) For the purpose of initial evaluations of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by the bidder:

(1) Obviously misplaced decimal points will be corrected;

(2) In case of discrepancy between unit prices and extended price, the unit price will govern;

(3) Apparent errors in extension of unit prices will be corrected; and

(4) Apparent errors in addition of lump-sum and extended prices will be corrected.

(b) For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

(c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

1 February 1995
26. WAGE RATES. The Wage Decisions of the Secretary of Labor are applicable to the work to be performed under this contract and are contained in SECTION 00800, SPECIAL CONTRACT REQUIREMENTS. Modifications are periodically made to the wage decisions. The complete modifications will be issued by amendment to the solicitation.

24 Sep 1998
27. MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS. The right is reserved, as the interest of the Government may require, to revise or amend the specifications and/or drawings prior to the date set for opening of bids. Such revisions and amendments, if any, will be announced by an amendment or amendments to this Invitation for Bids. Copies of such amendments as may be issued will be furnished to all prospective bidders. If the revisions and amendments are of a nature which require material changes in quantities or prices bid or both, the date set for opening bids may be postponed by such

number of days as in the opinion of the Contracting Officer will enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids.

24 Sep 1998
(1)28. NOTICE OF BUY AMERICAN ACT REQUIREMENTS – CONSTRUCTION MATERIALS. (MAY 1997) FAR 52.225-12

(a) Offerors are required to comply with the requirements of Federal Acquisition Regulation (FAR) clause 52.225-5, Buy American Act – Construction Materials, of this solicitation. The terms “construction material” and “domestic construction material,” as used in this provision, have the meanings set forth in FAR clause 52.225-5.

(b) Offerors should request a determination regarding the inapplicability of the Buy American Act in time to allow determination before submission of offers. For evaluation of a request for a determination regarding the inapplicability of the requirements of the Buy American Act prior to the time set for receipt of offers, the information and applicable supporting data required by paragraphs (c) and (d) of Far clause 52.225-5 shall be included in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act prior to submission of its offer, or has not received a response to a request made prior to submission of its offer, the information and supporting data shall be included in the offer.

(c) Evaluation of offers.

(1) For evaluation of offers, (unless agency regulations specify a higher percentage) the Government will add to the offered price 6 percent of the cost of any foreign construction material proposed for exception from the requirements of the Buy American Act based on claimed unreasonable cost of domestic construction materials in accordance with paragraph (b)(3)(i) of FAR clause 52.225-5.

(2) If the evaluation of offers results in a tie between an offer including such foreign construction material excepted on the basis of unreasonable cost, as evaluated, and an offer including solely domestic construction material or other foreign construction material listed in the solicitation at paragraph (b)(2) of FAR clause 52.225-5, or subsequently excepted in accordance with paragraphs (b)(3)(ii) or (iii) of FAR clause 52.225-5, award shall be made to the offeror that submitted the latter offer.

(d) Alternate offers.

(1) When an offer includes foreign construction material not listed by the Government in the solicitation at paragraph (b)(2) of Far clause 52.225-5, offerors also may submit alternate offers base on use of equivalent domestic construction.

(2) If alternate offers are submitted, a separate Standard Form 142 shall be submitted for each alternate offer, and a separate price comparison table, prepared in accordance with paragraph (c) and (d) of FAR clause 52.225-5, shall be submitted for each offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception to apply.

(3) If the Government determines that a particular exception requested under paragraph (c) of FAR clause 52.225-5 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic construction material, and the offeror shall be required to furnish such domestic construction material.

(i) In sealed bid procurements, any offer based on use of that particular foreign construction material shall be rejected as nonresponsive.

(ii) In negotiated procurements, any offer based on use of that particular foreign construction material may not be accepted unless revised during negotiations.

29. LISTING OF EMPLOYMENT OPENINGS. Offerors should note that this solicitation includes a provision requiring the listing of employment openings with the local office of the State employment service system if the award is for $10,000 or more.

22 June 1998
30. SUBMISSION OF INVOICES.

In accordance with Section 00010, Para. 24, submit invoices to:

Daryl Merryman
Building 1407 (public works building)
P.O Drawer B
Fort Eustis, VA

31. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (APR 1984) FAR 52.222-23.

(a) The Offeror's attention is called to the EQUAL OPPORTUNITY and the AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION clauses of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

.....

Goals for minority participation for each trade	Goals for female participation in each trade
□□□□□ 27.1%	6.9%

.....

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the Contractor performs construction work (whether or not it is Federal or Federally assisted) in a geographical area located outside the covered area, it shall apply the goals established for the geographical area where such work is actually performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs (OFCCP) Office.

(c) The Contractor's compliance with Executive Order 11246 as amended and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity clause, specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction" and its efforts to meet prescribed goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its

projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Director, OFCCP within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor, employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in the contract resulting from this Solicitation, the "covered area" is the economic area which includes Newport News/Hampton, Virginia.

32. NOT USED.

33. PERFORMANCE OF WORK BY CONTRACTOR. Attention is directed to SPECIAL CONTRACT REQUIREMENT: PERFORMANCE OF WORK BY CONTRACTOR. The apparent low bidder must furnish the Contracting Officer, within 5 working days after bid opening, a description of the work which he intends to perform with his own organization, e.g., earthwork, paving, brickwork, or roofing), the percentage of the total work this represents, and the estimated cost thereof.

15 September 1995
34. MODIFICATION OF BIDS BY FACSIMILE. Bidders WILL NOT be allowed to modify their bids at any time by facsimile or teletype.

35. PAYMENT FOR BOND PREMIUMS. CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS provides that upon presentation of evidence of full payment, the Government will immediately reimburse the Contractor the cost of premiums for performance and payment bonds. This reimbursement amount is not in addition to the amount bid for the work covered by this Invitation for Bids, and bidders are cautioned to include the cost of such premiums in the bid items shown on the Bidding Schedule (or in the lump sum amount of the bid if no bid items are listed). If bond premiums are reimbursed under this clause, such reimbursed amount will be recovered by the Government from the progress payments made to the Contractor or, if no progress payments are made, from the amount otherwise due the Contractor upon final payment.

36. NOT USED.

20 March 1997
37. NOT USED.

20 March 1997
38. SERVICE OF PROTEST (AUG 1996) FAR 52.233-2.

(a) Protests, as defined in Section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO) shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from:

Ms. Denise A. Bauer, Contracting Officer
U.S. Army Engineer District, Louisville
Corps of Engineers - ATTN: CEORLCT
600 Dr. Martin Luther King Jr. Place, Room 821

Louisville, Kentucky 40202-2230

(b) The copy of any protest shall be received in the office designated above on the same day a protest is filed with the GSBCA or within one day of filing a protest with the GAO.

39. COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (DEC 1991) DFARS 252.204-7001

(a) The Offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter CAGE before the number.

(b) If the Offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Services Center (DLSC). The Contracting Officer will--

(1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

(2) Complete section A and forward the form to DLSC; and

(3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

20 March 1997
40. DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (APR 1998) FAR 52.204-6.

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation “DUNS” followed by the DUNS number that identifies the offeror’s name and address exactly as stated in the offer. The DUNS number is a nine-digit number assigned by Dun and Bradstreet Information Services.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

(1) Company name.
(2) Company address.
(3) Company telephone number.
(4) Line of business.
(5) Chief executive officer/key manager.
(6) Date the company was started.
(7) Number of people employed by the company.
(8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet Home Page at hhtp://www.dnb.com/. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at globalinfo@mail.dnb.com.

20 August 1997
41. NOT USED.

20 March 1997
42. NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990) FAR 52.211-14.

42.1 Any contract awarded as a result of this solicitation will be a [ ] DX rated order; [X] DO-C2 rated order certified for national defense use under the Defense Priorities and Allocations System (DFARS) 15 CFR 700, and the Contractor will be required to follow all of the requirements of this regulation.

43. PRICE BASIS. Prices must be firm. Bids will not be considered which provide for subsequent increase in price.

24 Sep 1998
44. CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION (AUG 1996)
FAR 52.214-19.

(a) The Government will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

(b) The Government may reject any or all bids, and waive informalities on minor irregularities in bids received.

(c) The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

(d) The Government may reject a bid as nonresponsive if the prices bid are materially unbalanced between line items or subline items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Government even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

24 Sep 1998
45. NOT USED.

46. AWARD TO SINGLE BIDDERS. Subject to the provisions contained herein, award shall be made to a single bidder.

47. NOT USED.

48. NOT USED.

49. NOT USED.

LOCATION OF BID OPENING. Bidders are provided the following information as a service by the government. The government cannot be held liable for street closures, traffic delays or other problems that may be encountered due to reliance upon the government's suggested routes to the Federal Building.

Motorist coming from I-65 North:

Immediately after crossing the kennedy bridge, take exit I-64 West (St. Louis). Once in I-64, take the 9th street exit. Continue straight on 9th street for approximately seven blocks to Broadway (first major street with two-way traffic). Turn left on Broadway; go two blocks and turn left on 7th street (7th street is one-way north bound). Approximately ½ block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

Motorist coming from I-65 South:

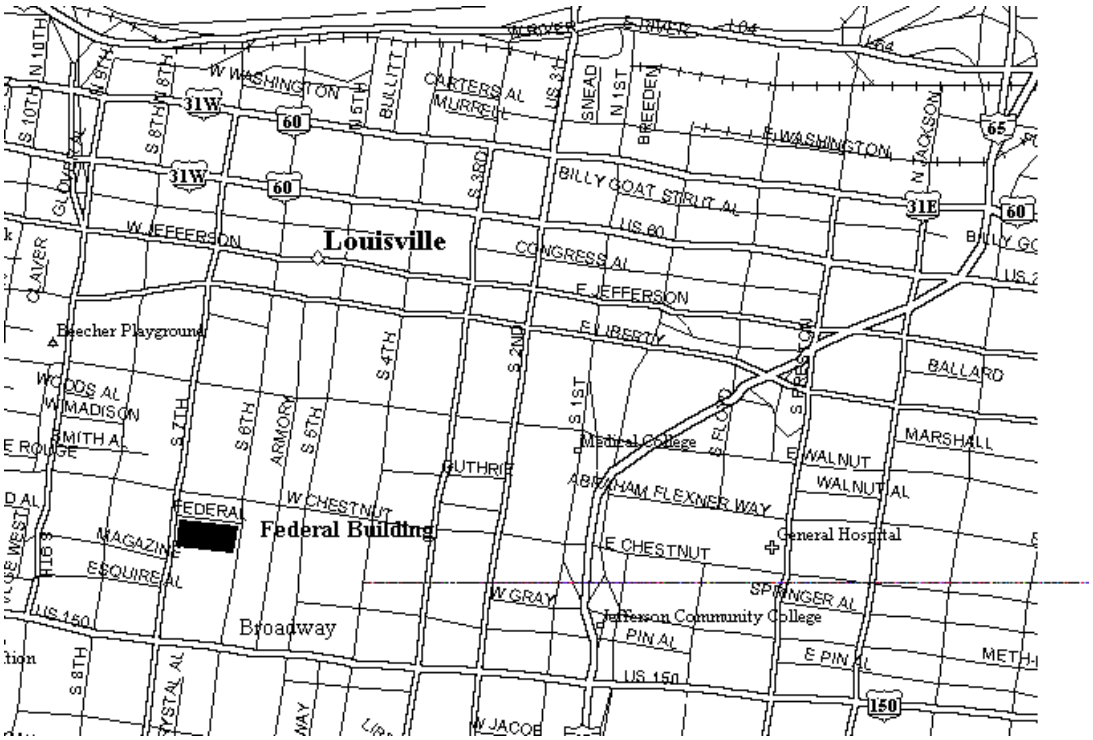
Take Broadway exit and turn left on Broadway (west bound) and continue to 7th street and turn right. Approximately ½ block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

Motorist coming from I-64 East and West:

Exit the 9th street exit. At the bottom of the ramp continue south down 9th street for approximately seven blocks until you come to Broadway (first major two way street). Turn left on Broadway and to two blocks and turn left on 7th street (7th street is one-way north bound). Approximately ½ block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

Motorist coming from I-71:

Follow routing for intersecting with I-64 and follow the instructions for I-64 motorists.



BIDDER: READ CAREFULLY - CHECK ALL APPLICABLE BOXES

SECTION 00605

REPRESENTATIONS, CERTIFICATIONS, AND OTHER STATEMENTS OF BIDDER FOR SEALED BID CONSTRUCTION CONTRACTS

DATE OF OFFER: _____ DUNS NO. _____

SOLICITATION NO. _____ CAGE NO. _____

NAME AND ADDRESS OF OFFEROR: _____

_____

The offeror makes the following representations and certifications as part of the offer referenced above.

1. CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985) FAR 52.203-2

(a) The offeror certifies that--

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to (i) those prices, (ii) the intention to submit an offer, or (iii) the methods or factors used to calculate the prices offered;

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory--

(1) Is the person in the offeror’s organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision _____ [*insert full name of person(s) in the offeror’s organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror’s organization*];

(ii) As an authorized agent, does certify that the principals name in subdivision (b)(2)(i) of this provision have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision.

(c) If the offeror deletes or modifies subparagraph (a)(2) of this provision, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of provision)

2. CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991) FAR 52.203-11

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of $100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than $10,000, and not more than $100,000, for each such failure.

(End of Provision)

3. TAXPAYER IDENTIFICATION (JUN 1997) FAR 52.204-3

(a) **Definitions.**

“Common parent,” as used in this solicitation provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

“Corporate status,” as used in this solicitation provision, means a designation as to whether the offeror is a corporate entity, an unincorporated entity (e.g., sole proprietorship or partnership), or a corporation providing medical and health care services.

“Taxpayer Identification Number (TIN),” as used in this solicitation provision, means the number required by the IRS to be used by the offeror in reporting income tax and other returns.

(b) All offerors are required to submit the information required in paragraphs (c) through (e) of this solicitation provision in order to comply with reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M and implementing regulations issued by the Internal Revenue Service (IRS). If the resulting contract is subject to the reporting requirements described in FAR 4.903, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) **Taxpayer Identification Number (TIN).**

[ ] TIN: _____
[ ] TIN has been applied for.
[ ] TIN is not required because:
- **[ ]** Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the U.S. and does not have an office or place of business or a fiscal paying agent in the U.S.;
- **[ ]** Offeror is an agency or instrumentality of a foreign government;
- **[ ]** Offeror is an agency or instrumentality of a Federal, state, or local government;
- **[ ]** Other. State basis.
  _____

(d) **Corporate Status.**

[ ] Corporation providing medical and health care services, or engaged in the billing and collecting of payments for such services;
[ ] Other corporate entity;
[ ] Not a corporate entity:
- **[ ]** Sole proprietorship
- **[ ]** Partnership
- **[ ]** Hospital or extended care facility described in 26 CFR 501(c)(3) that is exempt from taxation under 26 CFR 501(a).

(e) **Common Parent.**

[ ] Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.
[ ] Name and TIN of Common parent:

Name _____ TIN_____

(End of provision)

4. WOMEN-OWNED BUSINESS (OCT 1995) FAR 52.204-5

(a) **Representation.** The offeror represents that it **[ ]** is, **[ ]** is not a women-owned business concern.

(b) **Definition.** “Women-owned business concern,” as used in this provision, means a concern which is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(End of provision)

5. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (MAR 1996) FAR 52.209-5

(a) (1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals--

(A) Are **[ ]** are not **[ ]** presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have **[ ]** have not **[ ]**, within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are **[ ]** are not **[ ]** presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has **[ ]** has not **[ ]**, within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) “Principals,” for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror’s responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

6. DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (SEP 1994) DFARS 252.209-7001

(a) **Definitions.**

As used in this provision--

(1) “Government of a terrorist country” includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) “Terrorist country” means a country determined by the Secretary of State, under section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405 (j)(i)(A)), to be a country the government of which has repeatedly provided support for acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) “Significant interest” means--

(i) Ownership of or beneficial interest in 5 percent or more of the firm’s or subsidiary’s securities. Beneficial interest includes holding 5 percent or more of any class of the firm’s securities in “nominee shares,” “street names,” or some other method of holding securities that does not disclose the beneficial owner;

(ii) Holding a management position in the firm, such as a director or officer;

(iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;

(iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or

(v) Holding 50 percent or more of the indebtedness of a firm.

(b) **Prohibition on award.** In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) **Disclosure.** If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclose such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include--

(1) Identification of each government holding a significant interest; and

(2) A description of the significant interest held by each government.

(End of provision)

7. TYPE OF BUSINESS ORGANIZATION - SEALED BIDDING (JUL 1987) FAR 52.214-2

The bidder, by checking the applicable box, represents that--

(a) It operates as **[ ]** a corporation incorporated under the laws of the State of _____, **[ ]** an individual **[ ]** a partnership, **[ ]** a nonprofit organization, or **[ ]** a joint venture; or

(b) If the bidder is a foreign entity, it operates as **[ ]** an individual, **[ ]** a partnership, **[ ]** a nonprofit organization, **[ ]** a joint venture, or **[ ]** a corporation, registered for business in _____.
(country)

(End of provision)

8. SMALL BUSINESS PROGRAM REPRESENTATIONS (OCT 1998) FAR 52.219-1 (ALTERNATE I) (OCT 1998)

(a) (1) The standard industrial classification (SIC) code for this acquisition is 1542.

(2) The small business size standard is $17.0.

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) **Representations.** (1) The offeror represents as part of its offer that it **[ ]** is, **[ ]** is not a small business concern.

(2) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents, for general statistical purposes, that it **[ ]** is, **[ ]** is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it **[ ]** is **[ ]** is not a women-owned small business concern.

(4) (Complete if offeror represented itself as disadvantaged in paragraph (b)(2) of this provision). [The offeror shall check the category in which its ownership falls];

_____ Black American

_____ Hispanic American

_____ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

_____ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

_____ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

_____ Individual/concern, other than one of the preceding.

(c) **Definitions.**

“Small business concern,” as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

“Woman-owned small business concern,” as used in this provision, means a small business concern--

(1) Which is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) **Notice.** (1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm’s status as a small or small disadvantaged business concern in order to obtain a contract to be awarded under the preference programs established pursuant to sections 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

(i) Be punished by imposition of fine, imprisonment, or both;

(ii) Be subject to administrative remedies, including suspension and debarment; and

(iii) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

9. EQUAL LOW BIDS (OCT 1995) FAR 52.219-2

(a) This provision applies to small business concerns only.

(b) The bidder’s status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

_____ _____

_____ _____

(c) Failure to identify the labor surplus areas as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

(End of provision)

10. SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (JAN 1997) FAR 52.219-19

(a) **Definition.** “Emerging small business” as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the standard industrial classification code assigned to a contracting opportunity.

(b) **(Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.)** The Offeror **[ ]** is, **[ ]** is not an emerging small business.

(c) **(Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)** Offeror’s number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror’s average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts - see paragraph 11(a) (2) Small Business Program Representations).

(Construction Solicitations)

Number of Employees	Avg. Annual Gross Revenues
_____ 50 or fewer	_____ $1 million or less
_____ 51 - 100	_____ $1,000,001 - $2 million
_____ 101 -250	_____ $2,000,001 - $3.5 million
_____ 251 - 500	_____ $3,500,001 - $5 million
_____ 501 - 750	_____ $5,000,001 - $10 million
_____ 751 - 1,000	_____ $10,000,001 - $17 million
_____ Over 1,000	_____ Over $17 million

(End of provision)

11. CERTIFICATION OF NONSEGREGATED FACILITIES (APR 1984) FAR 52.222-21

(a) “Segregated facilities,” as used in this provision, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or otherwise.

(b) By the submission of this offer, the offeror certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The offeror agrees that a breach of this certification is a violation of the Equal Opportunity clause in the contract.

(c) The offeror further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will--

(1) Obtain identical certifications from proposed subcontractors before the award of subcontracts under which the subcontractor will be subject to the Equal Opportunity clause;

(2) Retain the certifications in the files; and

(3) Forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT
FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).
NOTE: The penalty for making false statements in offers is prescribed in 18. U.S.C. 1001.

(End of Provision)

12. PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (APR 1984) FAR 52.222-22

The offeror represents that--

(a) It **[ ]** has **[ ]** has not, participated in a previous contract or subcontract subject either to the Equal Opportunity clause of this solicitation, the clause originally contained in Section 310 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114;

(b) It **[ ]** has, **[ ]** has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of Provision)

13. CLEAN AIR AND WATER CERTIFICATION (APR 1984) FAR 52.223-1

The Offeror certifies that--

(a) Any facility to be used in the performance of this proposed contract **[ ]** is, **[ ]** is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities;

(b) The Offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the EPA, indicating that any facility that the Offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and

(c) The Offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

(End of Provision)

14. CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 1996) FAR 52.223-13

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8,1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facilities is exempt for at least one of the following reasons: *(Check each block that is applicable.)*

[ ] (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

[ ] (ii) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);

[ ] (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

[ ] (iv) The facility does not fall within the Standard Industrial Classification Code (SIC) designations 20 through 39 as set forth in section 19.102 of the Federal Acquisition Regulation; or

[ ] (v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of provision)

(End of Section 00605)

SECTION 00700

INDEX OF CONTRACT CLAUSES (CONSTRUCTION)
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TABLE OF CONTENTS

1 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991) DFARS 252.201-7000

2 DEFINITIONS (OCT 1995)--ALTERNATE I (APR 1984) FAR 52.202-1 I

3 GRATUITIES (APR 1984) FAR 52.203-3

4 COVENANT AGAINST CONTINGENT FEES (APR 1984) FAR 52.203-5

5 ANTI-KICKBACK PROCEDURES (JUL 1995) FAR 52.203-7

6 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) FAR 52.203-8

7 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) FAR 52.203-10

8 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997) FAR 52.203-12

9 SPECIAL PROHIBITION ON EMPLOYMENT (NOV 1995) DFARS 252.203-7001

10 DISPLAY OF DOD HOTLINE POSTER (DEC 1991) DFARS 252.203-7002

11 PRINTING/COPYING DOUBLE-SIDED ON RECYCLED PAPER (JUN 1996) FAR 52.204-4

12 REQUIRED CENTRAL CONTRACTOR REGISTRATION (MAR 1998) DFARS 252.204-7004

13 PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS (DEC 1991) DFARS 252.205-7000

14 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (JUL 1995) FAR 52.209-6

15 DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) FAR 211-15

16 VARIATION IN ESTIMATED QUANTITY (APR 1984) FAR 52.211-18

17 AUDIT AND RECORDS--SEALED BIDDING (OCT 1997) FAR 52.214-26

18 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS--SEALED BIDDING (OCT 1997) FAR 52.214-27

19 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS --SEALED BIDDING (OCT 1997) FAR 52.214-28

20 AUDIT AND RECORDS--NEGOTIATION (AUG 1996) FAR 52.215-2

21 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA (OCT 1997) FAR 52.215-10

22 SUBCONTRACTOR COST OR PRICING DATA (OCT 1997) FAR 52.215-12

23 TERMINATION OF DEFINED BENEFIT PENSION PLANS (OCT 1997) FAR 52.215-15

24 REVERSION OR ADJUSTMENT OF PLANS FOR POSTRETIREMENT BENEFITS (PRB) OTHER THAN PENSIONS (OCT 1997) FAR 52.215-18

25 NOTIFICATION OF OWNERSHIP CHANGES (OCT 1997) FAR 52.215-19

26 PRICING ADJUSTMENTS (DEC 1991) DFARS 252.215-7000

27 UTILIZATION OF SMALL, SMALL DISADVANTAGED AND WOMEN OWNED SMALL BUSINESS CONCERNS (JUN 1997) FAR 52.219-8

28 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1998) FAR 52.219-9

29 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1998) ALTERNATE I (OCT 1995) FAR 52.219-9 I

30 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1998) ALTERNATE II (MAR 1996) FAR 52.219-9 II

31 LIMITATIONS ON SUBCONTRACTING (DEC 1996) FAR 52.219-14

32 LIQUIDATED DAMAGES--SUBCONTRACTING PLAN (AUG 19098) FAR 52.219-16

33 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DOD CONTRACTS) (APR 1996) DFARS 252.219-7003

34 NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997) FAR 52.222-1

35 CONVICT LABOR (AUG 1996) FAR 52.222-3

36 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT--OVERTIME COMPENSATION (JUL 1995) FAR 52.222-4

37 DAVIS-BACON ACT (FEB 1995) FAR 52.222-6

38 WITHHOLDING OF FUNDS (FEB 1988) FAR 52.222-7

39 PAYROLLS AND BASIC RECORDS (FEB 1988) FAR 52.222-8

40 APPRENTICES AND TRAINEES (FEB 1988) FAR 52.222-9

41 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988) FAR 52.222-10

42 SUBCONTRACTS (LABOR STANDARDS) (FEB 1988) FAR 52.222-11

43 CONTRACT TERMINATION--DEBARMENT (FEB 1988) FAR 52.222-12

44 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988) FAR 52.222-13

45 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988) FAR 52.222-14

46 CERTIFICATION OF ELIGIBILITY (FEB 1988) FAR 52.222-15

47 EQUAL OPPORTUNITY (APR 1984) FAR 52.222-26

48 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (APR 1984) FAR 52.222-27

49 AFFIRMATIVE ACTION FOR DISABLED VETERANSAND VIETNAM ERA (APR 1998) FAR 52.222-35

50 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998) FAR 52.222-36

51 EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (APR 1998) FAR 52.222-37

52 CLEAN AIR AND WATER (APR 1984) FAR 52.223-2

53 POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (APR 1998) FAR 52.223-5

54 DRUG-FREE WORKPLACE (JAN 1997) FAR 52.223-6

55 OZONE-DEPLETING SUBSTANCES (JUN 1996) FAR 52.223-11

56 TOXIC CHEMICAL RELEASE REPORTING (OCT 1996) FAR 52.223-14

57 BUY-AMERICAN ACT--CONSTRUCTION MATERIALS (JUN 1997) FAR 52.225-5

58 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (AUG 1998) FAR 52.225-11

59 BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER EUROPEAN COMMUNITY AND NORTH AMERICAN FREE TRADE AGREEMENTS (JUN 1997) FAR 52.225-15

60 BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER EUROPEAN COMMUNITY AND NORTH AMERICAN FREE TRADE AGREEMENTS (MAY 1997) ALTERNATE I (MAY 1997) FAR 52.225-15 I

61 SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992) DFARS 252.225-7031

62 UTILIZATION OF INDIAN ORGANIZATIONS AND INDIAN-OWNED ECONOMIC ENTERPRISES (SEP 1996) FAR 52.226-1

63 AUTHORIZATION AND CONSENT (JUL 1995) FAR 52.227-1

64 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984) FAR 52.227-4

65 RIGHTS IN SHOP DRAWINGS (APR 1966) DFARS 252.227-7033

66 ADDITIONAL BOND SECURITY (OCT 1997) FAR 52.228-2

67 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997) FAR 52.228-5

68 PLEDGES OF ASSETS (FEB 1992) FAR 52.228-11

69 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (OCT 1995) FAR 52.228-12

70 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991) FAR 52.229-3

71 SUPPLEMENTAL COST PRINCIPLES (DEC 1991) DFARS 252.231-7000

72 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997) FAR 52.232-5

73 INTEREST (JUN 1996) FAR 52.232-17

74 ASSIGNMENT OF CLAIMS (JAN 1986) ALTERNATE I (APR 1984) FAR 52.232-23 I

75 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (JUN 1997) FAR 52.232-27

76 PAYMENT BY ELECTRONIC FUNDS TRANSFER (CCR) (JUN 1998) DFARS 252.232-7000

77 DISPUTES (OCT 1995) 52.233-1

78 PROTEST AFTER AWARD (AUG 1996) FAR 52.233-3

79 DIFFERING SITE CONDITIONS (APR 1984) FAR 52.236-2

80 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984) FAR 52.236-3

81 MATERIAL AND WORKMANSHIP (APR 1984) FAR 52.236-5

82 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984) FAR 52.236-6

83 PERMITS AND RESPONSIBILITIES (NOV 1991) FAR 52.236-7

84 OTHER CONTRACTS (APR 1984) FAR 52.236-8

85 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984) FAR 52.236-9

86 OPERATIONS AND STORAGE AREAS (APR 1984) FAR 52.236-10

87 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984) FAR 52.236-11

88 CLEANING UP (APR 1984) FAR 52.236-12

89 ACCIDENT PREVENTION (NOV 1991)--ALTERNATE I (NOV 1991) FAR 52.236-13 I

90 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984) FAR 52.236-15

91 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997) FAR 52.236-21

92 PRECONSTRUCTION CONFERENCE (FEB 1995) FAR 52.236-26

93 MODIFICATION PROPOSALS--PRICE BREAKDOWN (DEC 1991) DFARS 252.236-7000

94 BANKRUPTCY (JUL 1995) FAR 52.242-13

95 SUSPENSION OF WORK (APR 1984) FAR 52.242-14

96 POSTAWARD CONFERENCE (DEC 1991) DFARS 252.242-7000

97 CHANGES (AUG 1987) FAR 52.243-4

98 PRICING OF CONTRACT MODIFICATIONS (DEC 1991) DFARS 252.243-7001

99 CERTIFICATION OF REQUESTS FOR EQUITABLE ADJUSTMENT (JUL 1997) DFARS 252.243-7002

100 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989) FAR 52.245-2

101 GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (APR 1984) FAR 52.245-4

102 REPORTS OF GOVERNMENT PROPERTY (MAY 1994) DFARS 252.245-7001

103 INSPECTION OF CONSTRUCTION (AUG 1996) FAR 52.246-12

104 VALUE ENGINEERING--CONSTRUCTION (MAR 1989) ALTERNATE I (APR 1984) FAR 52.248-3 I

105 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SEP 1996)--ALTERNATE I (SEP 1996) FAR 52.249-2 I

106 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984) FAR 52.249-10

107 COMPUTER GENERATED FORMS (JAN 1991) FAR 52.253-1

1. CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991) DFARS 252.201-7000

(a) *Definition*. "Contracting officer's representative" means an individual designated in accordance with subsection 201.602-2 of the Defense Federal Acquisition Regulation Supplement and authorized in writing by the Contracting Officer to perform specific technical or administrative functions.

(b) If the Contracting Officer designates a Contracting Officer's Representative (COR), the Contractor will receive a copy of the written designation. It will specify the extent of the COR's authority to act on behalf of the Contracting Officer. The COR is not authorized to make any commitments or changes that will affect price, quality, quantity, delivery, or any other term or condition of the contract.

(End of clause)

2. DEFINITIONS (OCT 1995)--ALTERNATE I (APR 1984) FAR 52.202-1 I

(a) "Head of the agency" (also called "agency head") or "Secretary" means the Secretary (or Attorney General, Administrator, Governor, Chairperson, or other chief official, as appropriate) of the agency, including any deputy or assistant chief official of the agency; and the term "authorized representative" means any person, persons, or board (other than the Contracting Officer) authorized to act for the head of the agency or Secretary.

(b) "Commercial component" means any component that is a commercial item.

(c) "Component" means any item supplied to the Federal Government as part of an end item or of another component.

(d) "Nondevelopmental item" means--

(1) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;

(2) Any item described in paragraph (d)(1) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or

(3) Any item of supply being produced that does not meet the requirements of paragraph (d)(1) or (d)(2) solely because the item is not yet in use.

(e) "Contracting Officer" means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(f) Except as otherwise provided in this contract, the term "subcontracts" includes, but is not limited to, purchase orders and changes and modifications to purchase orders under this contract.

(End of clause)

3. GRATUITIES (APR 1984) FAR 52.203-3

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to an officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) of this clause, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c)(2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

4. COVENANT AGAINST CONTINGENT FEES (APR 1984) FAR 52.203-5

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annual this contract without liability or, in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract or any basis other than the merits of the matter.

(End of clause)

5. ANTI-KICKBACK PROCEDURES (JUL 1995) FAR 52.203-7

(a) *Definitions*.

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided, directly or indirectly, to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract.

"Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment or services of any kind.

"Prime Contractor" as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) The Anti-Kickback Act of 1986 (41 U.S.C. 51-58) (the Act), prohibits any person from--

(1) Providing or attempting to provide or offering to provide any kickback;

(2) Soliciting, accepting, or attempting to accept any kickback; or

(3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c)(1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Department of Justice.

(3) The Contractor shall cooperate fully with any Federal agency investigating a possible violation described in paragraph (b) of this clause.

(4) The Contracting Officer may (i) offset the amount of the kickback against any monies owed by the United States under the prime contract and/or (ii) direct that the Prime Contractor withhold from sums owed a subcontractor under the prime contract the amount of the kickback. The Contracting Officer may order that monies withheld under subdivision (c)(4)(ii) of this clause be paid to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the Prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract which exceed $100,000.

(End of clause)

6. CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) FAR 52.203-8

(a) If the Government receives information that a contractor or a person has engaged in conduct constituting a violation of subsection (a), (b), (c), or (d) of Section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423) (the Act), as amended by section 4304 of the 1996 National Defense Authorization Act for Fiscal Year 1996 (Pub.L. 104-106), the Government may--

(1) Cancel the solicitation, if the contract has not yet been awarded or issued; or

(2) Rescind the contract with respect to which--

(i) The Contractor or someone acting for the Contractor has been convicted for an offense where the conduct constitutes a violation of subsection 27 (a) or (b) of the Act for the purpose of either--

(A) Exchanging the information covered by such subsections for anything of value; or

(B) Obtaining or giving anyone a competitive advantage in the award of a Federal agency procurement contract; or

(ii) The head of the contracting activity has determined, based upon a preponderance of the evidence, that the Contractor or someone acting for the Contractor has engaged in conduct constituting an offense punishable under subsections 27(e) (1) of the Act.

(b) If the Government rescinds the contract under paragraph (a) of this clause, the Government is entitled to recover, in addition to any penalty prescribed by law, the amount expended under the contract.

(c) The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law, regulation, or under this contract.

(End of clause)

7. PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) FAR 52.203-10

(a) The Government, at its election, may reduce the price of a fixed-price type contract and the total cost and fee under a cost-type contract by the amount of profit or fee determined as set forth in paragraph (b) of this clause if the head of the contracting activity or designee determines that there was a violation of subsection 27(a), (b), or (c) of the Office of Federal Procurement Policy Act, as amended (41 U.S.C. 423), as implemented in section 3.104 of the Federal Acquisition Regulation. In the case of a contract modification, the fee subject to reduction is the fee specified in the particular contract modification at the time of execution, except as provided in subparagraph (b)(5) of this clause.

(b) The price or fee reduction referred to in paragraph (a) of this clause shall be--

(1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;

(2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award, notwithstanding any minimum fee or “fee floor” specified in the contract;

(3) For cost-plus-award-fee contracts--

(i) For base fee established in the contract at the time of contract award;

(ii) If no base fee is specified in the contract, 30 percent of the amount of each award fee otherwise payable to the Contractor for each award fee evaluation period or at each award fee determination point.

(4) For fixed-price-incentive contracts, the Government may--

(i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award; or

(ii) If an immediate adjustment to the contract target price and contract target profit would have a significant adverse impact on the incentive price revision relationship under the contract, or adversely affect the contract financing provisions, the Contracting Officer may defer such adjustment until establishment of the total final price of the contract.

The total final price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price.

(5) For firm-fixed price contracts, by 10 percent of the initial contract price or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award.

(c) The Government may, at its election, reduce a prime contractor's price or fee in accordance with the procedures of paragraph (b) of this clause for violations of the Act by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(d) In addition to the remedies in paragraphs (a) and (c) of this clause, the Government may terminate this contract for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

8. LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997) FAR 52.203-12

(a) *Definitions.*

"Agency," as used in this clause, means executive agency as defined in 2.101.

"Covered Federal action," as used in this clause, means any of the following Federal actions:

(1) The awarding of any Federal contract.

(2) The making of any Federal grant.

(3) The making of any Federal loan.

(4) The entering into of any cooperative agreement.

(5) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

"Indian tribe" and "tribal organization," as used in this clause, have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and include Alaskan Natives.

"Influencing or attempting to influence," as used in this clause, means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government," as used in this clause, means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Officer or employee of an agency," as used in this clause, includes the following individuals who are employed by an agency:

(1) An individual who is appointed to a position in the Government under title 5, United States Code, including a position under a temporary appointment.

(2) A member of the uniformed services, as defined in subsection 101(3), title 37, United States Code.

(3) A special Government employee, as defined in section 202, title 18, United States Code.

(4) An individual who is a member of a Federal advisory committee, as defined by the Federal advisory Committee Act, title 5, United States Code, appendix 2.

"Person," as used in this clause, means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit, or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation," as used in this clause, means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment," as used in this clause, means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient," as used in this clause, includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Regularly employed," as used in this clause, means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

"State," as used in this clause, means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, a territory or possession of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

(b) *Prohibitions*.

(1) Section 1352 of title 31, United States Code, among other things, prohibits a recipient of a Federal contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan or cooperative agreement.

(2) The Act also requires Contractors to furnish a disclosure if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

(3) The prohibitions of the Act do not apply under the following conditions:

(i) *Agency and legislative liaison by own employees*.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of a payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action if the payment is for agency and legislative liaison activities not directly related to a covered Federal action.

(B) For purposes of subdivision (b)(3)(i)(A) of this clause, providing any information specifically requested by an agency or Congress is permitted at any time.

(C) The following agency and legislative liaison activities are permitted at any time where they are not related to a specific solicitation for any covered Federal action:

(1) Discussing with an agency the qualities and characteristics (including individual demonstrations) of the person's products or services, conditions or terms of sale, and service capabilities.

(2) Technical discussions and other activities regarding the application or adaptation of the person's products or services for an agency's use.

(D) The following agency and legislative liaison activities are permitted where they are prior to formal solicitation of any covered Federal action--

(1) Providing any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

(2) Technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

(3) Capability presentations by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Pub. L. 95-507, and subsequent amendments.

(E) Only those services expressly authorized by subdivision (b)(3)(i)(A) of this clause are permitted under this clause.

(ii) *Professional and technical services*.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of--

(1) A payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal

action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

(2) Any reasonable payment to a person, other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.

(B) For purposes of subdivision (b)(3)(ii)(A) of this clause, "professional and technical services" shall be limited to advice and analysis directly applying any professional or technical discipline. For example, drafting of a legal document accompanying a bid or proposal by a lawyer is allowable. Similarly, technical advice provided by an engineer on the performance of operational capability of a piece of equipment rendered directly in the negotiation of a contract is allowable. However, communications with the intent to influence made by a professional (such as a licensed lawyer) or a technical person (such as a licensed accountant) are not allowable under this section unless they provide advice and analysis directly applying their professional or technical expertise and unless the advice or analysis is rendered directly and solely in the preparation, submission or negotiation of a covered Federal action. Thus, for example, communications with the intent to influence made by a lawyer that do not provide legal advice or analysis directly and solely related to the legal aspects of this or her client's proposal, but generally advocate one proposal over another are not allowable under this section because the lawyer is not providing professional legal services. Similarly, communications with the intent to influence made by an engineer providing an engineering analysis prior to the preparation or submission of a bid or proposal are not allowable under this section since the engineer is providing technical services but not directly in the preparation, submission or negotiation of a covered Federal action.

(C) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation and any other requirements in the actual award documents.

(D) Only those services expressly authorized by subdivisions (b)(3)(ii)(A)(1) and (2) of this clause are permitted under this clause.

(E) The reporting requirements of FAR 3.803(a) shall not apply with respect to payments of reasonable compensation made to regularly employed officers or employees of a person.

(c) *Disclosure*.

(1) The Contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using nonappropriated funds (to include profits from any covered Federal action), which would be prohibited under subparagraph (b)(1) of this clause, if paid for with appropriated funds.

(2) The Contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously filed by such person under subparagraph (c)(1) of this clause. An event that materially affects the accuracy of the information reported includes--

(i) A cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing are attempting to influence a covered Federal action; or

(ii) A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or

(iii) A change in the officer(s), employee(s), or Member(s) contacted to influence or attempting to influence a covered Federal action.

(3) The Contractor shall require the submittal of a certification, and if required, a disclosure form by any person who requests or receives any subcontract exceeding $100,000 under the Federal contract.

(4) All subcontractor disclosure forms (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall submit all disclosures to the Contracting Officer at the end of the

calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(d) *Agreement*. The Contractor agrees not to make any payment prohibited by this clause.

(e) *Penalties*.

(1) Any person who makes an expenditure prohibited under paragraph (a) of this clause or who fails to file or amend the disclosure form to be filed or amended by paragraph (b) of this clause shall be subject to civil penalties as provided for by 31 U.S.C. 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(2) Contractors may rely without liability on the representation made by their subcontractors in the certification and disclosure form.

(f) *Cost allowability*. Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

(End of clause)

9. SPECIAL PROHIBITION ON EMPLOYMENT (NOV 1995) DFARS 252.203-7001

(a) *Definitions*. As used in this clause--

(1) "Arising out of a contract with the DoD" means any act in connection with--

(i) Attempting to obtain,

(ii) Obtaining, or

(iii) Performing a contract or first-tier subcontract of any agency, department, or component of the Department of Defense (DoD).

(2) "Conviction of fraud or any other felony" means any conviction for fraud or a felony in violation of state or Federal criminal statutes, whether entered on a verdict or plea, including a plea of *nolo contendere*, for which sentence has been imposed.

(3) "Date of conviction" means the date judgment was entered against the individual.

(b) 10 U.S.C. 2408 provides that any individual who is convicted after September 29, 1988, of fraud or any other felony arising out of a contract with the DoD is prohibited from:

(1) Working in a management or supervisory capacity on any DoD contract or first-tier subcontract;

(2) Serving on the board of directors of any DoD contractor or fist-tier subcontractor; or

(3) Serving as a consultant to any DoD contractor or first-tier subcontractor.

(c) Unless waived, the prohibition in paragraph (b) applies for five years from the date of conviction.

(d) 10 U.S.C. 2408 further provides that a defense contractor or first-tier subcontractor shall be subject to a criminal penalty of not more than $500,000 if convicted of knowingly--

(1) Employing a person under a prohibition specified in paragraph (b) of this clause; or

(2) Allowing such a person to serve on the board of directors of the contractor or first-tier subcontractor.

(c) In addition to the criminal penalties contained in 10 U.S.C. 2408, the Government may consider other available remedies, such as--

(1) Suspension or debarment;

(2) Cancellation of the contract at no cost to the Government; or

(3) Termination of the contract for default.

(f) The Contractor may submit written requests for waiver of the prohibitions in paragraph (b) of this clause to the Contracting Officer. Requests shall clearly identify--

(1) The person involved;

(2) The nature of the conviction and resultant sentence or punishment imposed;

(3) The reasons for the requested waiver, and

(4) An explanation of why a waiver is in the interest of national security.

(g) The Contractor agrees to include the substance of this clause, appropriately modified to reflect the identify and relationship of the parties, in all first-tier subcontracts exceeding the simplified acquisition threshold in part 13 of the Federal Acquisition Regulation, except those for commercial items or components.

(h) Pursuant to 10 U.S.C. 2408(c), defense contractors and subcontractors may obtain information as to whether a particular person has been convicted of fraud or any other felony arising out of a contract with the DoD by contacting The Office of Justice Programs, The Denial of Benefits Office, U.S. Department of Justice, telephone (202) 307-1065.

(End of clause)

10. DISPLAY OF DOD HOTLINE POSTER (DEC 1991) DFARS 252.203-7002

(a) The Contractor shall display prominently in common work areas within business segments performing work under Department of Defense (DoD) contracts, DoD Hotline Posters prepared by the DoD Office of the Inspector General.

(b) DoD Hotline Posters may be obtained from the DoD Inspector General, ATTN: Defense Hotline, 400 Army Navy Drive, Washington, DC 22202-2884.

(c) The Contractor need not comply with paragraph (a) of this clause if it has established a mechanism, such as a hotline, by which employees may report suspected instances of improper conduct, and instructions that encourage employees to make such reports.

(End of clause)

11. PRINTING/COPYING DOUBLE-SIDED ON RECYCLED PAPER (JUN 1996)
FAR 52.204-4

(a) In accordance with Executive Order 12873, dated October 20, 1993, as amended by Executive Order 12995, dated March 25, 1996, the Offeror/Contractor is encouraged to submit paper documents, such as offers, letters, or reports, that are printed/copied double-sided on recycled paper that has at least 20 percent postconsumer material.

(b) The 20 percent standard applies to high-speed copier paper offset paper, forms bond, computer printout paper, carbonless paper, file folders, white woven envelopes, and other uncoated printed and writing paper such as writing and office paper, book paper, cotton fiber paper, and cover stock. An alternative to meeting the 20 percent postconsumer material standards is 50 percent recovered material content of certain industrial by-products.

(End of clause)

12. REQUIRED CENTRAL CONTRACTOR REGISTRATION (MAR 1998)
DFARS 52.204-7004

(a) Definitions. As used in this clause—

(1) Central Contractor Registration (CCR) database means the primary DoD repository for contractor information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun and Bradstreet Information Services to identify unique business entities.

(3) Data Universal Numbering System+4 (DUNS+4) number means the DUNS number assigned by Dun and Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registered in the CCR database means that all mandatory information including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

(b) (1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during the performance, and through final payment of any contract resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offer ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

(c) The Contractor is responsible for the accuracy and completeness of the data within the CCR and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after initial registration, the Contractor is required to confirm on an annual basis that its information in the CCR database is accurate and complete.

(d) Offerors and contractors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at http://ccr.edi.disa.mil.

(End of clause)

13. PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS (DEC 1991) DFARS 252.205-7000

(a) *Definition*.

"Cooperative agreement holder" means a State or local government; a private, nonprofit organization; a tribal organization (as defined in section 4(c) of the Indian Self-Determination and Education Assistance Act (Pub. L. 93-268; 25 U.S.C. 450(c)); or an economic enterprise (as defined in section 3(e) of the Indian Financing Act of 1974 (Pub. L. 93-362; 25 U.S.C. 1452(e)) whether such economic enterprise is organized for profit or nonprofit purposes; which has an agreement with the Defense Logistics Agency to furnish procurement technical assistance to business entities.

(b) The Contractor shall provide cooperative agreement holders, upon their request, with a list of those appropriate employees or offices responsible for entering into subcontracts under defense contracts. The list shall include the business address, telephone number, and area of responsibility of each employee or office.

(c) The Contractor need not provide the listing to a particular cooperative agreement holder more frequently than once a year.

(End of clause)

14. PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (JUL 1995) FAR 52.209-6

(a) The Government suspends or debars Contractors to protect the Government's interests. The Contractor shall not enter into any subcontract in excess of $25,000 with a Contractor that is debarred, suspended, or proposed for debarment unless there is a compelling reason to do so.

(b) The Contractor shall require each proposed first-tier subcontractor, whose subcontract will exceed $25,000, to disclose to the Contractor, in writing, whether as of the time of award of the subcontract, the subcontractor, or its principals, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(c) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs). The notice must include the following:

(1) The name of the subcontractor.

(2) The Contractor's knowledge of the reasons for the subcontractor being on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(3) The compelling reasons(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded From Federal Procurement and Nonprocurement Programs.

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interest when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(End of clause)

15. DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) FAR 52.211-15

NOTE: This clause applies only to military contracts.

This is a rated order certified for national defense use, and the contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR 700).

(End of clause)

16. VARIATION IN ESTIMATED QUANTITY (APR 1984) FAR 52.211-18

If the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent above or below the estimated quantity, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above 115 percent or below 85 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contractor may request, in writing, an extension of time, to

be received by the Contracting Officer within 10 days from the beginning of the delay, or within such further period as may be granted by the Contracting Officer before the date of final settlement of the contract. Upon the receipt of a written request for an extension, the Contracting Officer shall ascertain the facts and make an adjustment for extending the completion date as, in the judgment of the Contracting Officer, is justified.

(End of clause)

17. AUDIT AND RECORDS--SEALED BIDDING (OCT 1997) FAR 52.214-26

NOTE: This clause applies only to sealed bid contracts.

(a) As used in this clause, "records" includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) *Cost or pricing data*. If the Contractor has been required to submit cost or pricing data in connection with the pricing of any modification to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

(1) The proposal for the modification;

(2) The discussions conducted on the proposal(s), including those related to negotiating;

(3) Pricing of the modification; or

(4) Performance of the modification.

(c) *Comptroller General*. In the case of pricing any modification, the Comptroller General of the United States, or an authorized representative, shall have the same rights as specified in paragraph (b) of this clause.

(d) *Availability*. The Contractor shall make available at its office at all reasonable times the materials described in paragraph (b) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract, or for any other period specified in Subpart 4.7 of the Federal Acquisition Regulation (FAR). FAR Subpart 4.7, Contractor Records Retention, in effect on the date of this contract, is incorporated by reference in its entirety and made a part of this contract.

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement.

(2) Records pertaining to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to the performance of this contract shall be made available until disposition of such appeals, litigation, or claims.

(e) The Contractor shall insert a clause containing all the provisions of this clause, including this paragraph (e), in all subcontracts expected to exceed the threshold in FAR 15.403-4(a)(1) for submission of cost or pricing data.

(End of clause)

18. PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS--SEALED BIDDING (OCT 1997) FAR 52.214-27

NOTE: This clause applies only to sealed bid contracts

(a) This clause shall become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for the submission of cost or pricing data at FAR 15.403-4(a)(1), except that this clause does not apply to a modification if an exception under FAR 15.403-1(b) applies.

(b) If any price, including profit, negotiated in connection with any modification under this clause, was increased by any significant amount because (1) the Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data, (2) a subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or (3) any of these parties furnished data of any description that were not accurate, the price shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) of this clause.

(c) Any reduction in the contract price under paragraph (b) of this clause due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead

and profit markup, by which (1) the actual subcontract or (2) the actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(d)(1) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2)(i) Except as prohibited by subdivision (d)(2)(ii) of this clause, an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the cost or pricing data were available before the date of agreement on the price of the contract (or price of the modification) and that the data were not submitted before such date.

(ii) An offset shall not be allowed if--

(A) The understated data was known by the Contractor to be understated when the Certificate of Current Cost or Pricing Data was signed; or

(B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data has been submitted before the date of agreement on price.

(e) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid--

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable underpayment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621 (a)(2); and

(2) A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted cost or pricing data which were incomplete, inaccurate, or noncurrent.

(End of clause)

19. SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS-SEALED BIDDING (OCT 1997) FAR 52.214-28

NOTE: This clause applies only to sealed bid contracts.

(a) The requirements of paragraphs (b) and (c) of this clause shall (1) become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), and (2) be limited to such modifications.

(b) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modifications involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specified identification in writing), unless an exception under FAR 15.403-1(b) applies.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in subsection FAR 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (b) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(d) The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that, when entered into, exceeds the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1).

(End of clause)

20. AUDIT AND RECORDS--NEGOTIATION (AUG 1996) FAR 52.215-2

NOTE: This clause applies only to negotiated contracts.

(a) As used in this clause, "records" includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) *Examination of costs*. If this is a cost-reimbursement, incentive, time-and-materials, labor-hour, or price redeterminable contract, or any combination of these, the Contractor shall maintain and the Contracting Officer, or an authorized representative of the Contracting Officer, shall have the right to examine and audit all records and other evidence sufficient to reflect properly all costs claimed to have been incurred or anticipated to be incurred directly or indirectly in performance of this contract. This right of examination shall include inspection at all reasonable times of the Contractor's plants, or parts of them, engaged in performing the contract.

(c) *Cost or pricing data*. If the Contractor has been required to submit cost or pricing data in connection with any pricing action relating to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

(1) The proposal for the contract, subcontract, or modification;

(2) The discussions conducted on the proposal(s), including those related to negotiating;

(3) Pricing of the contract, subcontract, or modification; or

(4) Performance of the contract, subcontract or modification.

(d) *Comptroller General*.--(1) The Comptroller General of the United States, or an authorized representative, shall have access to and the right to examine any of the Contractor's directly pertinent records involving transactions related to this contract or a subcontract hereunder.

(2) This paragraph may not be construed to require the Contractor or subcontractor to create or maintain any record that the Contractor or subcontractor does not maintain in the ordinary course of business or pursuant to a provision of law.

(e) *Reports*. If the Contractor is required to furnish cost, funding, or performance reports, the Contracting Officer or an authorized representative of the Contracting Officer shall have the right to examine and audit the supporting records and materials, for the purpose of evaluating (1) the effectiveness of the Contractor's policies and procedures to produce data compatible with the objectives of these reports and (2) the data reported.

(f) *Availability*. The Contractor shall make available at its office at all reasonable times the records, materials, and other evidence described in paragraphs (a), (b), (c), (d), and (e) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract, or for any shorter period specified in Subpart 4.7, Contractor Records Retention, of the Federal Acquisition Regulation (FAR), or for any longer period required by statute or by other clauses of this contract. In addition--

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement; and

(2) Records relating to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to this contract shall be made available until such appeals, litigation, or claims are finally resolved.

(g) The Contractor shall insert a clause containing all the terms of this clause, including this paragraph (g), in all subcontracts under this contract that exceed the simplified acquisition threshold, and--

(1) That are cost-reimbursement, incentive, time-and-materials, labor-hour, or price-redeterminable type or any combination of these;

(2) For which cost or pricing data are required; or

(3) That require the subcontractor to furnish reports as discussed in paragraph (c) of this clause.

The clause may be altered only as necessary to identify properly the contracting parties and the Contracting Officer under the Government prime contract.

(End of clause)

21. PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA (OCT 1997) FAR 52.215-10

NOTE: This clause applies only to negotiated contracts.

(a) If any price, including profit or fee, negotiated in connection with this contract, or any cost reimbursable under this contract, was increased by any significant amount because --(1) The Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data; (2) A subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or (3) Any of these parties furnished data of any description that were not accurate, the price or cost shall be reduced accordingly and the contract shall be modified to reflect the reduction.

(b) Any reduction in the contract price under paragraph (a) of this clause due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which (1) The actual subcontract; or (2) The actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(c)(1) If the Contracting Officer determines under paragraph (a) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2)(i) Except as prohibited by subdivision (c)(2)(ii) of this clause, an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the cost or pricing data were available before the "as of" date specified on its Certificate of Current Cost or Pricing Data, and that the data were not submitted before such date

(ii) An offset shall not be allowed if--

(A) The understated data was known by the Contractor to be understated before the "as of" date specified on its Certificate of Current Cost or Pricing Data; or

(B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data has been submitted before the "as of" date specified on its Certificate of Current Cost or Pricing Data.

(d) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid--

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable under payment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621(a)(2); and

(2) A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted cost or pricing data which were incomplete, inaccurate, or noncurrent.

(End of clause)

22. SUBCONTRACTOR COST OR PRICING DATA (OCT 1997) FAR 52.215-12

NOTE: This clause applies only to negotiated contracts.

(a) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modification involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless an exception under FAR 15.403-1 applies.

(b) The Contractor shall require the subcontractor to certify in substantially the form prescribed in subsection 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (a) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(c) In each subcontract that exceeds the threshold for submission of cost or pricing data at FAR 15.403-4, when entered into, the Contractor shall insert either--

(1) The substance of this clause, including this paragraph (c), if paragraph (a) of this clause requires submission of cost or pricing data for the subcontract; or

(2) The substance of the clause at FAR 52.215-13, Subcontractor Cost or Pricing Data--Modifications.

(End of clause)

23. TERMINATION OF DEFINED BENEFIT PENSION PLANS (OCT 1997) FAR 52.215-15

NOTE: This clause applies only to negotiated contracts.

The Contractor shall promptly notify the Contracting Officer in writing when it determines that it will terminate a defined benefit pension plan or otherwise recapture such pension fund assets. If pension fund assets revert to the Contractor or are constructively received by it under a termination or otherwise, the Contractor shall make a refund or give a credit to the Government for its equitable share as required by FAR 31.205-6(j)(4). The Contractor shall include the substance of this clause in all subcontracts under this contract which meet the applicability requirements of FAR 15.408(g).

(End of clause)

24. REVERSION OR ADJUSTMENT OF PLANS FOR POSTRETIREMENT BENEFITS (PRB) OTHER THAN PENSIONS (OCT 1997) FAR 52.215-18

NOTE: This clause applies only to negotiated contracts.

The Contractor shall promptly notify the Contracting Officer in writing when it determines that it will terminate or reduce a PRB plan. If PRB fund assets revert, or inure, to the Contractor or are constructively received by it under a plan termination or otherwise, the Contractor shall make a refund or give a credit to the Government for its equitable share as required by FAR 31.205-6(o)(6). The Contractor shall include the substance of this clause in all subcontracts under this contract which meet the applicability requirements of FAR 15.408(j)

(End of clause)

25. NOTIFICATION OF OWNERSHIP CHANGES (OCT 1997) FAR 52.215-19

NOTE: This clause applies only to negotiated contracts.

(a) The Contractor shall make the following notifications in writing:

(1) When the Contractor becomes aware that a change in its ownership has occurred, or is certain to occur, which could result in changes in the valuation of its capitalized assets in the accounting records, the Contractor shall notify the Administrative Contracting Officer (ACO) within 30 days.

(2) The Contractor shall also notify the ACO within 30 days whenever changes to asset valuations or any other cost changes have occurred or are certain to occur as a result of a change in ownership.

(b) The Contractor shall-- (1) Maintain current, accurate, and complete inventory records of assets and their costs; (2) Provide the ACO or designated representative ready access to the records upon request; (3) Ensure that all individual and grouped assets, their capitalized values, accumulated depreciation or amortization, and remaining useful lives are identified accurately before and after each of the Contractor's ownership changes; and (4) Retain and continue to maintain depreciation and amortization schedules based on the asset records maintained before each Contractor ownership change.

(c) The Contractor shall include the substance of this clause in all subcontracts under this contract which meet the applicability requirement of FAR 15.408(k).

(End of clause)

26. PRICING ADJUSTMENTS (DEC 1991) DFARS 252.215-7000

NOTE: This clause applies only to negotiated contracts.

The term "pricing adjustment," as used in paragraph (a) of the clauses entitled "Price Reduction for Defective Cost or Pricing Data - Modifications," "Subcontractor Cost or Pricing Data," and "Subcontractor Cost or Pricing Data - Modifications," means the aggregate increases and/or decreases in cost plus applicable profits.

(End of clause)

27. UTILIZATION OF SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS CONCERNS (JUN 1997) FAR 52.219-8

(a) It is the policy of the United States that small business concerns, small business concerns owned and controlled by socially and economically disadvantaged individuals and small business concerns owned and controlled by women shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, small business concerns owned and controlled by socially and economically disadvantaged individuals and small business concerns owned and controlled by women.

(b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

(c) As used in this contract, the term "small business concern" shall mean a small business as defined pursuant to section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. The term "small business concern owned and controlled by socially and economically disadvantaged individuals" shall mean a small business concern (1) which is at least 51 percent unconditionally owned by one or more socially and economically disadvantaged individuals; or, in the case of any publicly owned business, at least 51 per centum of the stock of which is unconditionally owned by one or more socially and economically disadvantaged individuals; and (2) whose management and daily business operations are controlled by one or more of such individuals. This term also means a small business concern that is at least 51 percent unconditionally owned by an economically disadvantaged Indian tribe or Native Hawaiian Organization, or a publicly owned business having at least 51 percent of its stock unconditionally owned by one of these entities which has its management and daily business controlled by members of an economically disadvantaged Indian tribe or Native Hawaiian Organization, and which meets the requirements of 13 CFR 124. The Contractor shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Subcontinent Asian Americans, and other minorities, or any other individual found to be disadvantaged by the Administration pursuant to section 8(a) of the Small Business Act. The Contractor shall presume that socially and economically disadvantaged entities also include Indian Tribes and Native Hawaiian Organizations.

(d) The term "small business concern owned and controlled by women" shall mean a small business concern (1) which is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women, and (2) whose management and daily business operations are controlled by one or more women; and

(e) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as a small business concern, a small business concern owned and controlled by socially and economically disadvantaged individuals or a small business concern owned and controlled by women.

(End of clause)

28. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1998) FAR 52.219-9

NOTE: This clause applies to negotiated solicitations over $1,000,000.00. See also FAR 52.219-9 II below

(a) This clause does not apply to small business concerns.

(b) Definitions. As used in this clause—

"Commercial item" means a product or service that satisfies the definition of commercial item in section 2.101 of the Federal Acquisition Regulation.

"Commercial plan" means a subcontracting plan (including goals) that covers the offeror's fiscal year and that applies to the entire production of commercial items sold by either the entire company or a portion thereof (e.g., division, plant, or product line).

"Individual contract plan" means a subcontracting plan that covers the entire contract period (including option periods), applies to a specific contract, and has goals that are based on the offeror's planned subcontracting in support of the specific contract, except that indirect costs incurred for common or joint purposes may be allocated on a prorated basis to the contract.

"Master plan" means a subcontracting plan that contains all the required elements of an individual contract plan, except goals, and may be incorporated into individual contract plans, provided the master plan has been approved.

"Subcontract" means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The offeror, upon request by the Contracting Officer, shall submit and negotiate a subcontracting plan, where applicable, which separately addresses subcontracting with small business concerns, with small disadvantaged business concerns and with women-owned small business concerns. If the offeror is submitting an individual contract plan, the plan must separately address subcontracting with small business concerns, small disadvantaged business concerns, and women-owned small business concerns with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be negotiated within the time specified by the Contracting Officer. Failure to submit and negotiate the subcontracting plan shall make the offeror ineligible for award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business concerns, small disadvantaged business concerns and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted for an individual contract plan; or the offeror's total projected sales, expressed in dollars, and the total value of projected subcontracts to support the sales for a commercial plan;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(iv) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to—

(i) Small business concerns;

(ii) Small disadvantaged business concerns; and

(iii) Women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the methods used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Automated Source System (PASS) of the Small Business Administration, the National Minority Purchasing Council Vendor Information Service, the Research and Information Division of the Minority Business Development Agency in the Department of Commerce, or small, small disadvantaged and women-owned small business concerns trade associations). A firm may rely on the information contained in PASS as an accurate representation of a concern's size and ownership characteristics for purposes of maintaining a small business source list. A firm may rely on PASS as its small business source list. Use of the PASS as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns, (ii) small disadvantaged business concerns, and (iii) women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small, small disadvantaged and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause in this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) who receive subcontracts in excess of $500,000 ($1,000,000 for construction of any public facility) to adopt a subcontracting plan that complies with the requirements of this clause.

(10) Assurances that the offeror will—

(i) Cooperate in any studies or surveys as may be required;

(ii) Submit periodic reports so that the Government can determine the extent of compliance by the offeror with the subcontracting plan;

(iii) Submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, following the instructions on the forms or as provided in agency regulations; and

(iv) Ensure that its subcontractors agree to submit SF 294 and 295.

(11) A description of the types of records that will be maintained concerning procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small, small disadvantaged and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (e.g., PASS), guides, and other data that identify small, small disadvantaged and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small, small disadvantaged or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than $100,000, indicating (A) whether small business concerns were solicited and if not, why not, (B) whether small disadvantaged business concerns were solicited and if not, why not, (C) whether women-owned small business concerns were solicited and if not, why not, and (D) if applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact (A) trade associations, (B) business development organizations, and (C) conferences and trade fairs to locate small, small disadvantaged and women-owned small business sources.

(v) Records of internal guidance and encouragement provided to buyers through (A) workshops, seminars, training, etc., and (B) monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having commercial plans need to comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small, small disadvantaged and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small, small disadvantaged and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small, small disadvantaged and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representative of small, small disadvantaged and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, small disadvantaged or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master plan on a plant or division-wide basis that contains all the elements required by paragraph (d) of this clause, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided—

(1) The master plan has been approved

(2) The offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer; and

(3) Goals and any deviations from the master plan deemed necessary by the Contacting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) A commercial plan is the preferred type of subcontracting plan for contractors furnishing commercial items. The commercial shall plan relate to the offeror's planned subcontracting generally, for both commercial and Government business, rather than solely to the Government contract. Commercial plans are also preferred for subcontractors that provide commercial items under a prime contract, whether or not the prime contractor is supplying a commercial item.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(End of clause)

29. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1998) ALTERNATE I (OCT 1995) FAR 52.219-9 I

NOTE: This clause applies only to sealed-bid solicitations over $1,000,000.00.

(a) This clause does not apply to small business concerns.

(b) Definitions. As used in this clause—

"Commercial item" means a product or service that satisfies the definition of commercial item in section 2.101 of the Federal Acquisition Regulation.

"Commercial plan" means a subcontracting plan (including goals) that covers the offeror's fiscal year and that applies to the entire production of commercial items sold by either the entire company or a portion thereof (e.g., division, plant, or product line).

"Individual contract plan" means a subcontracting plan that covers the entire contract period (including option periods), applies to a specific contract, and has goals that are based on the offeror's planned subcontracting in support of the specific contract, except that indirect costs incurred for common or joint purposes may be allocated on a prorated basis to the contract.

"Master plan" means a subcontracting plan that contains all the required elements of an individual contract plan, except goals, and may be incorporated into individual contract plans, provided the master plan has been approved.

"Subcontract" means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The apparent low bidder, upon request by the Contracting Officer, shall submit a subcontracting plan, where applicable, which separately addresses subcontracting with small business concerns, with small disadvantaged business concerns and with women-owned small business concerns. If the bidder is submitting an individual contract plan, the plan must separately address subcontracting with small business concerns, small disadvantaged business concerns, and women-owned small business concerns, with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be submitted within the time specified by the Contracting Officer. Failure to submit the subcontracting plan shall make the bidder ineligible for the award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business concerns, small disadvantaged business concerns and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted for an individual contract plan; or the offeror's total projected sales, expressed in dollars, and the total value of projected subcontractor to support the sales for a commercial plan;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(iv) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to—

(i) Small business concerns;

(ii) Small disadvantaged business concerns; and

(iii) Women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the methods used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Automated Source System (PASS) of the Small Business Administration, the National Minority Purchasing Council Vendor Information Service, the Research Information Division of the Minority Business Development Agency in the Department of Commerce, or small, small disadvantaged and women-owned small business concerns trade associations). A firm may rely on the information contained in PASS as an accurate representation of a concern's size and ownership characteristics for purposes of maintaining a small business source list. A firm may rely on PASS as its small business source list. Use of the PASS as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns, (ii) small disadvantaged business concerns, and (iii) women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small, small disadvantaged and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause in this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) who receive subcontracts in excess of $500,000 ($1,000,000 for construction of any public facility) to adopt a subcontracting plan that complies with the requirements of this clause.

(10) Assurances that the offeror will—

(i) Cooperate in any studies or surveys as may be required;

(ii) Submit periodic reports so that the Government can determine the extent of compliance by the offeror with the subcontracting plan;

(iii) Submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, following the instructions on the forms or as provided in agency regulations; and

(iv) Ensure that its subcontractors agree to submit SF 294 and 295.

(11) A description of the types of records that will be maintained concerning procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small, small disadvantaged and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (e.g., PASS), guides, and other data that identify small, small disadvantaged and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small, small disadvantaged or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than $100,000, indicating (A) whether small business concerns were solicited and if not, why not, (B) whether small disadvantaged business concerns were solicited and if not, why not, (C) whether women-owned small business concerns were solicited and if not, why not, and (D) if applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact (A) trade associations, (B) business development organizations, and (C) conferences and trade fairs to locate small, small disadvantaged and women-owned small business sources.

(v) Records of internal guidance and encouragement provided to buyers through (A) workshops, seminars, training, etc., and (B) monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having commercial plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small, small disadvantaged and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small, small disadvantaged and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small, small disadvantaged and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representative of small, small disadvantaged and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, small disadvantaged or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master plan on a plant or division-wide basis that contains all the elements required by paragraph (d) of this clause, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided—

(1) The master plan has been approved

(2) The offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer; and

(3) Goals and any deviations from the master plan deemed necessary by the Contacting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) A commercial plan is the preferred type of subcontracting plan for contractors furnishing commercial items. The commercial shall plan relate to the offeror's planned subcontracting generally, for both commercial and Government business, rather than solely to the Government contract. Commercial plans are also preferred for subcontractors that provide commercial items under a prime contract, whether or not the prime contractor is supplying a commercial item.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(End of clause)

30. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1998) ALTERNATE II (MAR 1996) FAR 52.219-9 II

NOTE: This clause applies only to negotiated solicitations over $1,000,000, when a subcontracting plan is required with the initial proposal as described in Sections 00110 & 00115.

(a) This clause does not apply to small business concerns.

(b) Definitions. As used in this clause—

"Commercial item" means a product or service that satisfies the definition of commercial item in section 2.101 of the Federal Acquisition Regulation.

"Commercial plan" means a subcontracting plan (including goals) that covers the offeror's fiscal year and that applies to the entire production of commercial items sold by either the entire company or a portion thereof (e.g., division, plant, or product line).

"Individual contract plan" means a subcontracting plan that covers the entire contract period (including option periods), applies to a specific contract, and has goals that are based on the offeror's planned subcontracting in support of the specific contract, except that indirect costs incurred for common or joint purposes may be allocated on a prorated basis to the contract.

"Master plan" means a subcontracting plan that contains all the required elements of an individual contract plan, except goals, and may be incorporated into individual contract plans, provided the master plan has been approved.

"Subcontract" means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) Proposals submitted in response to this solicitation shall include a subcontracting plan, which separately addresses subcontracting with small business concerns, small disadvantaged business concerns and women-owned small business concerns. If the offeror is submitting an individual contract plan, the plan must separately address subcontracting with small business concerns, small disadvantaged business concerns and women-owned small business concerns with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be negotiated within the time specified by the Contracting Officer. Failure to submit and negotiate a subcontracting plan shall make the offeror ineligible for award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business concerns, small disadvantaged business concerns and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted for an individual contract plan; or the offeror's total projected sales, expressed in dollars, and the total value of projected subcontracts to support the sales for a commercial plan;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(iv) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to—

(i) Small business concerns;

(ii) Small disadvantaged business concerns; and

(iii) Women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the methods used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Automated Source System (PASS) of the Small Business Administration, the National Minority Purchasing Council Vendor Information Service, the Research Information Division of the Minority Business Development Agency in the Department of Commerce, or small, small disadvantaged and women-owned small business concerns trade associations). A firm may rely on the information contained in PASS as an accurate representation of a concern's size and ownership characteristics for purposes of maintaining a small business source list. A firm may rely on PASS as its small business source list. Use of the PASS as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns, (ii) small disadvantaged business concerns, and (iii) women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small, small disadvantaged and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause in this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) who receive subcontracts in excess of $500,000 ($1,000,000 for construction of any public facility) to adopt a subcontracting plan that complies with the requirements of this clause.

(10) Assurances that the offeror will—

(i) Cooperate in any studies or surveys as may be required;

(ii) Submit periodic reports so that the Government can determine the extent of compliance by the offeror with the subcontracting plan;

(iii) Submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, following the instructions on the forms or as provided in agency regulations; and

(iv) Ensure that its subcontractors agree to submit SF 294 and 295.

(11) A description of the types of records that will be maintained concerning procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small, small disadvantaged and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (e.g., PASS), guides, and other data that identify small, small disadvantaged and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small, small disadvantaged or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than $100,000, indicating (A) whether small business concerns were solicited and if not, why not, (B) whether small disadvantaged business concerns were solicited and if not, why not, (C) whether women-owned small business concerns were solicited and if not, why not, and (D) if applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact (A) trade associations, (B) business development organizations, and (C) conferences and trade fairs to locate small, small disadvantaged and women-owned small business sources.

(v) Records of internal guidance and encouragement provided to buyers through (A) workshops, seminars, training, etc., and (B) monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having commercial plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small, small disadvantaged and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small, small disadvantaged and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small, small disadvantaged and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representative of small, small disadvantaged and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, small disadvantaged or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master plan on a plant or division-wide basis that contains all the elements required by paragraph (d) of this clause, except goals may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided—

(1) The master plan has been approved;

(2) The offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer; and

(3) Goals and any deviations from the master plan deemed necessary by the Contacting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) A commercial plan is the preferred type of subcontracting plan for contractors furnishing commercial items. The commercial shall plan relate to the offeror's planned subcontracting generally, for both commercial and Government business, rather than solely to the Government contract. Commercial plans are also preferred for subcontractors that provide commercial items under a prime contract, whether or not the prime contractor is supplying a commercial item.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(End of clause)

31. LIMITATIONS ON SUBCONTRACTING (DEC 1996) FAR 52.219-14

NOTE: This clause applies only if the contract, or any portion of the contract is set-aside for small business or set-aside for the 8(a) program.

(a) This clause does not apply to the unrestricted portion of a partial set-aside.

(b) By submission of an offer and execution of a contract, the Offeror/Contractor agrees that in performance of the contract in the case of a contract for--

(1) *Services (except construction)*. At least 50 percent of the cost of contract performance incurred for personnel shall be expended for employees of the concern.

(2) *Supplies (other than procurement from a nonmanufacturer of such supplies)*. The concern shall perform work for at least 50 percent of the cost of manufacturing the supplies, not including the cost of materials.

(3) *General construction*. The concern will perform at least 15 percent of the cost of the contract, not including the cost of materials, with its own employees.

(4) *Construction by special trade contractors*. The concern will perform at least 25 percent of the cost of the contract, not including the cost of materials, with its own employees.

(End of clause)

32. LIQUIDATED DAMAGES--SUBCONTRACTING PLAN (OCT 1995) FAR 52.219-16

(a) "Failure to make a good faith effort to comply with the subcontracting plan", as used in this clause, means a willful or intentional failure to perform in accordance with the requirements of the subcontracting plan approved under the clause in this contract entitled "Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan," or willful or intentional action to frustrate the plan.

(b) Performance shall be measured by applying the percentage goals to the total actual subcontracting dollars or, if a commercial plan is involved, to the pro rata share of actual subcontracting dollars attributable to Government contracts covered by the commercial plan. If, at contract completion, or in the case of a commercial product plan, at the close of the fiscal year for which the plan is applicable, the Contractor has failed to meet its subcontracting goals and the Contracting Officer decides in accordance with paragraph (c) of this clause that the Contractor failed to make a good faith effort to comply with its subcontracting plan, established in accordance with the clause in this contract entitled "Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan," the Contractor shall pay the Government liquidated damages in an amount stated. The amount of probable damages attributable to the Contractor's failure to comply, shall be an amount equal to the actual dollar amount by which the Contractor failed to achieve each subcontract goal or, in the case of a commercial products plan, that portion of the dollar amount allocable to Government contracts by which the Contractor failed to achieve each subcontract goal.

(c) Before the Contracting Officer makes a final decision that the Contractor has failed to make such good faith effort, the Contracting Officer shall give the Contractor written notice specifying the failure and permitting the Contractor to demonstrate what good faith efforts have been made and to discuss the matter. Failure to respond to the notice may be taken as an admission that no valid explanation exists. If, after consideration of all pertinent data, the Contracting Officer finds that the Contractor failed to make a good faith effort to comply with the subcontracting plan, the Contracting Officer shall issue a final decision to that effect and require that the Contractor pay the Government liquidated damages as provided in paragraph (b) of this clause.

(d) With respect to commercial plans, the Contracting Officer approved the plan will perform the functions of the Contracting Officer under this clause on behalf of all agencies that awarded contracts covered by that commercial product plan.

(e) The Contractor shall have the right of appeal, under the clause in this contract entitled, Disputes, from any final decision of the Contracting Officer.

(f) Liquidated damages shall be in addition to any other remedies that the Government may have.

(End of clause)

33. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DoD CONTRACTS) (APR 1996) DFARS 252.219-7003

This clause supplements the Federal Acquisition Regulation 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, clause of this contract.

(a) *Definitions*.

"Historically black colleges and universities," as used in this clause, means institutions determined by the Secretary of Education to meet the requirements of 34 CFR Section 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.

"Minority institutions," as used in this clause, means institutions meeting the requirement of Section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1135d-5(3)). The term also includes Hispanic-serving institutions as defined in Section 316(b)(1) of such Act (20 U.S.C. 1059c(b)(1)).

(b) Except for company or division-wide commercial items subcontracting plans, the term "small disadvantaged business," when used in the FAR 52.219-9 clause, includes historically black colleges and universities and minority institutions, in addition to small disadvantaged business concerns.

(c) Work under the contract or its subcontracts shall be credited toward meeting the small disadvantaged business concern goal required by paragraph (d) of the FAR 52.219-9 clause when:

(1) It is performed on Indian lands or in joint venture with an Indian tribe or a tribally-owned corporation, and

(2) It meets the requirements of 10 U.S.C. 2323a.

(d) Subcontracts awarded to workshops approved by the Committee for Purchase from People Who are Blind or Severely Disabled (41 U.S.C. 46-48), may be counted toward the Contractor's small business subcontracting goal.

(e) A mentor firm, under the Pilot Mentor-Protégé Program established under Section 831 of Pub. L. 101-510, as amended, may count toward its small disadvantaged business goal, subcontracts awarded--

(1) Protégé firms which are qualified organizations employing the severely handicapped; and

(2) Former protégé firms that meet the criteria in Section 831(g)(4) of Pub. L. 101-510.

(f) The master plan approval referred to in paragraph (f) of the FAR 52.219-9 clause is approval by the Contractor's cognizant contract administration activity.

(g) In those subcontracting plans which specifically identify small, small disadvantaged, and women-owned small businesses, the Contractor shall notify the Administrative Contracting Officer of any substitutions of firms that are not small, small disadvantaged, or women-owned small businesses for the firms listed in the subcontracting plan.

Notifications shall be in writing and shall occur within a reasonable period of time after award of the subcontract. Contractor-specified formats shall be acceptable.

(End of clause)

34. NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997) FAR 52.222-1

If the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the Contractor shall immediate give notice, including all relevant information, to the Contracting Officer.

(End of clause)

35 CONVICT LABOR (AUG 1996) FAR 52.222-3

The Contractor agrees not to employ in the performance of this contract any person undergoing a sentence of imprisonment which has been imposed by any court of a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands. This limitation, however, shall not prohibit the employment by the Contractor in the performance of this contract of persons on parole or probation to work at paid employment during the term of their sentence or persons who have been pardoned or who have served their terms. Nor shall it prohibit the employment by the Contractor in the performance of this contract of persons confined for violation of the laws of any of the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

(a) (1) The worker is paid or is in an approved work training program on a voluntary basis;

(2) Representatives of local union central bodies or similar labor union organizations have been consulted;

(3) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services;

(4) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and

(b) The Attorney General of the United States has certified that the work-release laws or regulations of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943.

(End of clause)

36. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT--OVERTIME COMPENSATION (JUL 1995) FAR 52.222-4

(a) *Overtime requirements*. No Contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics (see Federal Acquisition Regulation (FAR) 22.300) shall require or permit any such laborers or mechanics in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than 1-1/2 times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(b) *Violation; liability for unpaid wages; liquidated damages*. In the event of any violation of the provisions set forth in paragraph (a) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanical employed in violation of the provisions set forth in paragraph (a) of this clause in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by provisions set forth in paragraph (a) of this clause.

(c) *Withholding for unpaid wages and liquidated damages*. The Contracting Officer shall upon his or her own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same Prime Contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same Prime Contractor, such sums as may be determined to be

necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the provisions set forth in paragraph (b) of this clause.

(d) *Payrolls and basic records*. (1) The Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of contract work and shall preserve them for a period of 3 years from the completion of the contract for all laborers and mechanics working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Nothing in this paragraph shall require the duplication of records required to be maintained for construction work by Department of Labor regulations at 29 CFR 5.5(a)(3) implementing the Davis-Bacon Act.

(2) The records to be maintained under paragraph (d)(1) of this clause shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit such representatives to interview employees during working hours on the job.

(e) *Subcontracts*. The Contractor or subcontractor shall insert in any subcontracts exceeding $100,000 the provisions set forth in paragraphs (a) through (e) of this clause and also a clause requiring the subcontractors to include these provisions in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the provisions set forth in paragraphs (a) through (e) of this clause.

(End of clause)

37. DAVIS-BACON ACT (FEB 1995) FAR 52.222-6

(a) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (d) of this clause; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such period. Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (b) of this clause) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(b)(1) The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approved an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination.

(ii) The classification is utilized in the area by the construction industry.

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (b)(2) and (b)(3) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(c) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(d) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(End of clause)

38. WITHHOLDING OF FUNDS (FEB 1988) FAR 52.222-7

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(End of clause)

39. PAYROLLS AND BASIC RECORDS (FEB 1988) FAR 52.222-8

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Davis-Bacon Act, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(b)(1) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph (a) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents. U.S. Government Printing Office, Washington, DC 20402. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2) of this clause.

(4) The falsification of any of the certifications in this clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(End of clause)

40. APPRENTICES AND TRAINEES (FEB 1988) FAR 52.222-9

(a) *Apprentices*. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rates) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) *Trainees*. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and

Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) *Equal employment opportunity*. The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(End of clause)

41. COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988) FAR 52.222-10

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

(End of clause)

42. SUBCONTRACTS (LABOR STANDARDS) (FEB 1988) FAR 52.222-11

(a) The Contractor or subcontractor shall insert in any subcontracts the clauses entitled *Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Withholding of Funds, Subcontracts (Labor Standards), Contract Termination--Debarment, Disputes Concerning Labor Standards, Compliance with Davis-Bacon and Related Act Regulations, and Certification of Eligibility,* and such other clauses as the Contracting Officer may, by appropriate instructions, require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with all the contract clauses cited in this paragraph.

(b)(1) Within 14 days after award of the contract, the Contractor shall delivery to the Contracting Officer a completed Statement and Acknowledgment Form (SF 1413) for each subcontract, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (a) of this clause have been included in the subcontract.

(2) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall delivery to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

(End of clause)

43. CONTRACT TERMINATION--DEBARMENT (FEB 1988) FAR 52.222-12

A breach of the contract clauses entitled *Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Davis-Bacon and Related Act Regulations, or Certification of Eligibility*, may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.

(End of clause)

44. COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988) FAR 52.222-13

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are hereby incorporated by reference in this contract.

(End of clause)

45. DISPUTES CONCERNING LABOR STANDARDS (FEB 1988) FAR 52.222-14

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(End of clause)

46. CERTIFICATION OF ELIGIBILITY (FEB 1988) FAR 52.222-15

(a) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(End of clause)

47. EQUAL OPPORTUNITY (APR 1984) FAR 52.222-26

(a) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of $10,000, the Contractor shall comply with subparagraphs (b)(1) through (11) below. Upon request, the Contractor all provide information necessary to determine the applicability of this clause.

(b) During performing this contract, the Contractor agrees as follows:

(1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

(2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (i) employment, (ii) upgrading, (iii) demotion, (iv) transfer, (v) recruitment or recruitment advertising, (vi) layoff or termination, (vii) rates of pay or other forms of compensation, and (viii) selection for training, including apprenticeship.

(3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

(4) The Contractor shall, in all solicitations or advertisement for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(5) The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(6) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(7) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of labor. Standard Form 100 (EEO-1), or any successor form, is the prescribed form to be filed within 30 days following the award, unless filed within 12 months preceding the date of award.

(8) The Contractor shall permit access to its books, records, and accounts by the contracting agency or the Office of Federal Contract Compliance Programs (OFCCP) for the purposes of investigation to ascertain the Contractor's compliance with the applicable rules, regulations, and orders.

(9) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended, the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law.

(10) The Contractor shall include the terms and conditions of subparagraph (b)(1) through (11) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontract or vendor.

(11) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(c) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.

(End of clause)

48. AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (APR 1984) FAR 52.222-27

(a) *Definitions*.

"Covered area," as used in this clause, means the geographical area described in the solicitation for this contract.

"Director," as used in this clause, means Director, Office of Federal Contract Compliance Programs (OFCCP), United States Department of Labor, or any person to whom the Director delegates authority.

"Employer identification number," as used in this clause, means the Federal Social Security number used on the employer's quarterly federal tax return, U.S. Treasury Department For 941.

"Minority," as used in this clause, means--

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin);

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race);

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade, each such subcontract in excess of $10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) above.

(6) Disseminate the Contractor's equal employment policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions. Conduct review of this policy with all onsite supervisory personnel before initiating construction work at a job site. A written record shall be made an maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to, and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative actions obligations contained in subparagraphs (g)(1) through (16). The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participate may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16), provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Make a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246, as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to carry out these sanctions and penalties as ordered shall be a violation of this clause and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) above, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Director shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

(o) Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(End of clause)

49. AFFIRMATIVE ACTION FOR DISABLED AND VIETNAM ERA VETERANS (APR 1998) FAR 52.222-35

(a) *Definition.* As used in this clause--.

All employment openings includes all positions except executive and top management, those positions that will be filled from within the contractor's organization, and positions lasting 3 days or less. This term includes full-time employment, temporary employment of more than 3 days' duration, and part-time employment.

Appropriate office of the State employment service system, means the local office of the Federal-State national system of public employment offices with assigned responsibility to serve the area where the employment opening is to be filled including the District of Columbia, Guam, the Commonwealth of Puerto Rico, and the Virgin Islands.

Positions that will be filled from within the Contractor's organization means employment openings for which no considered will be given to persons outside the Contractor's organization (including affiliates, subsidiaries, and parent companies) and includes any openings that the Contractor proposes to fill from regularly established "recall" lists. The exception does not apply to a particular opening once an employee decides to consider applicants outside of its organization.

Veteran of the Vietnam era means a person who--

(1) Served on active duty for a period of more than 180 days, any part of which occurred between August 5, 1964, and May 7, 1975, and was discharged or released therefrom with other than a dishonorable discharge; or

(2) Was discharged or released from active duty for a service-connected disability if any part of such active duty was performed between August 5, 1964, and May 7, 1975.

(b) *General*. (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against the individual because the individual is a disabled veteran or a veteran of the Vietnam era. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified disabled veterans and veterans of the Vietnam era without discrimination based upon their disability or veterans' status in all employment practices such as--

(i) Employment;
(ii) Upgrading;
(iii) Demotion or transfer;
(iv) Recruitment;
(v) Advertising;
(vi) Layoff or termination;
(vii) Rates of pay or other forms of compensation; and
(viii) Selection for training, including apprenticeship.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Vietnam Era Veterans' Readjustment Assistance Act of 1972 (the Act), as amended.

(c) *Listing openings*. (1) The Contractor agrees to list all employment openings existing at contract award or occurring during contract performance, at an appropriate office of the State employment service system in the locality where the opening occurs. These openings include those occurring at any Contractor facility, including one not connected with performing this contract. An independent corporate affiliate is exempt from this requirement.

(2) State and local government agencies holding Federal contracts of $10,000 or more shall also list all employment openings with the appropriate office of the State employment service.

(3) The listing of employment openings with the State employment service system is required at least concurrently with using any other recruitment source or effort and involves the obligations of placing a bona fide job order, including accepting referrals of veterans and nonveterans. This listing does not require hiring any particular job applicant or hiring from any particular group of job applicants and is not intended to relieve the Contractor from any requirements of Executive orders or regulations concerning nondiscrimination in employment.

(4) Whenever the Contractor becomes contractually bound to the listing terms of this clause, it shall advise the State employment service system, in each State where it has establishments, of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these terms and has so advised the State system, it need not advise the State system of subsequent contracts. The Contractor may advise the State system when it is no longer bound by this contract clause.

(d) *Applicability*. This clause does not apply to the listing of employment openings which occur and are filled outside the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, and the Virgin Islands.

(e) *Postings*. (1) The Contractor agrees to post employment notices stating (i) the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era, and (ii) the rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. They shall be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance Programs, Department of Labor (Deputy Assistant Secretary), and provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of the Act, and is committed to take affirmative action to employ, and advance in employment, qualified disabled veterans and veterans of the Vietnam Era.

(f) *Noncompliance*. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(g) *Subcontracts*. The Contractor shall include the terms of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

(End of clause)

50. AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)
FAR 52.222-36

(a) General. (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against any employee or applicant because of physical or mental disability. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified individuals with disabilities without discrimination based upon their physical or mental disability in all employment practices such as—

(i) Recruitment, advertising, and job application procedures;

(ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff, and rehiring;

(iii) Rates of pay or any other form of compensation and changes in compensation;

(iv) Job assignments, job classifications, organizational structures, position descriptions, lines of progression, and seniority lists;

(v) Leaves of absence, sick leave, or any other leave;

(vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;

(vii) Selection and financial support for training, including apprenticeships, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;

(viii) Activities sponsored by the Contractor, including social or recreational programs; and

(ix) Any other term, condition, or privilege of employment.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Rehabilitation Act of 1973 (29 U.S.C. 793) (the Act), as amended.

(b) Postings. (1) The Contractor agrees to post employment notices stating—

(i) The Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified individuals with disabilities; and

(ii) The rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. The Contractor shall ensure that applicants and employees with disabilities are informed of the contents of the notice (*e.g.*, the Contractor may have the notice read to a visually disabled individual, or may lower the posted notice so that it might be read by a person in a wheelchair). The notices shall be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance of the U.S. Department of Labor (Deputy Assistant Secretary) and shall be provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Act and is committed to take affirmative action to employ, and advance in employment, qualified individuals with physical and mental disabilities.

(c) Noncompliance. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(d) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of $10,000 unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

(End of clause)

51. EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (APR 1998) FAR 52.222-37

(a) Unless the Contractor is a State or local government agency, the contractor shall report at least annually, as required by the Secretary of Labor, on--

(1) The number of disabled veterans and the number of veterans of the Vietnam era in the workplace of the contractor by job category and hiring location; and

(2) The total number of new employees hired during the period covered by the report, and of that total, the number of disabled veterans, and the number of veterans of the Vietnam era.

(b) The above items shall be reported by completing the form entitled "Federal Contractor Veterans' Employment Report VETS-100."

(c) Reports shall be submitted no later than March 31 of each year beginning March 31, 1988.

(d) The employment activity report required by paragraph (a)(2) of this clause shall reflect total hires during the most recent 12-month period as of the ending data selected for the employment profile report required by paragraph (a)(1) of this clause. Contractors may select an ending date: (1) As of the end of any pay period during the period January through March 1 of the year the report is due, or (2) as of December 31, if the contractor has previous written approval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(e) The count of veterans reported according to paragraph (a) of this clause shall be based on voluntary disclosure. Each contractor subject to the reporting requirements at 38 U.S.C.4212 shall invite all disabled veterans and veterans of the Vietnam era who wish to benefit under the affirmative action program at 38 U.S.C. 4212 to identify themselves to the contractor. The invitation shall state that the information is voluntarily provided; that the information will be kept confidential; that disclosure or refusal to provide the information will not subject the applicant or employee to any adverse treatment; and that the information will be used only in accordance with the regulations promulgated under 38 U.S.C. 4212.

(f) *Subcontracts*. The Contractor shall include the terms of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations, or orders of the Secretary.

(End of clause)

52. CLEAN AIR AND WATER (APR 1984) FAR 52.223-2

(a) "Air Act," as used in this clause, means the Clean Air Act (42 U.S.C. 7401 et seq.).

"Clean air standards," as used in this clause, means--

(1) Any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, work practices, or other requirements contained in, issued under, or otherwise adopted under the Air Act or Executive Order 11738;

(2) An applicable implementation plan as described in section 110(d) of the Air Act (42 U.S.C. 7410(d));

(3) An approved implementation procedure or plan under section 111(c) or section 111(d) of the Air Act (42 U.S.C. 7411(c) or (d)); or

(4) An approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 7412(d)).

"Clean water standards," as used in this clause, means any enforceable limitation, control, condition, prohibition, standard, or other requirement promulgated under the Water Act or contained in a permit issued to a discharger by the EPA or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by local government to ensure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. 1317).

"Compliance," as used in this clause, means compliance with--

(1) Clean air or water standards; or

(2) A schedule or plan ordered or approved by a court of competent jurisdiction, the EPA, or an air or water pollution control agency under the requirements of the Air Act or Water Act and related regulations.

"Facility," as used in this clause, means any building, plant, installation, structure, mine, vessel or other floating craft, location, or site of operations, owned, leased, or supervised by a Contractor or subcontractor, used in the performance of a contract or subcontract. When a location or site of operations includes more than one building, plant, installation, or structure, the entire location or site shall be deemed a facility except when the Administrator, or a designee, of the EPA determines that independent facilities are collocated in one geographical area.

"Water Act," as used in this clause, means Clean Water Act (33 U.S.C. 1251 et seq.).

(b) The Contractor agrees--

(1) To comply with the requirements of section 114 of the Clean Air Act (42 U.S.C. 7414) and section 308 of the Clean Water Act (33 U.S.C. 1318) relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, and all regulations and guidelines issued to implement those acts before the award of this contract;

(2) That no portion of the work required by this prime contract will be performed in a facility listed on the EPA List of Violating Facilities on the date when this contract was awarded unless and until the EPA eliminates the name of the facility from the listing;

(3) To use best efforts to comply with clean air standards and clean water standards at the facility in which the contract is being performed; and

(4) To insert the substance of this clause into any nonexempt subcontract, including this subparagraph (b)(4).

(End of clause)

53. POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (APR 1998) FAR 52.223-5

(a) Executive Order 12856 of August 3, 1993, requires Federal facilities to comply with the provisions of the Emergency Planning and Community Right-to-know Act of 1986 (EPCRA) (42 U.S.C. 11001-11050) and the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13101-13109).

(b) The Contractor shall provide all information needed by the Federal facility to comply with the emergency planning reporting requirements of Section 302 of EPCRA; the emergency notice requirements of Section 304 of EPCRA; the list of Material Data Safety Sheets required by Section 311 of EPCRA; the emergency and hazardous chemical inventory forms of Section 312 of EPCRA; the toxic chemical release inventory of Section 313 of EPCRA, which includes the reduction and recycling information required by Section 6607 of PPA; and the toxic chemical reduction goals requirements of Section 3-302 of Executive Order 12856.

(End of clause)

54. DRUG-FREE WORKPLACE (JAN 1997) FAR 52.223-6

(a) Definitions. As used in this clause--

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11-1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession or use of any controlled substance.

"Drug-free workplace" means the site(s) for the performance of work done by the Contractor in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract. "Directly engaged" is defined to include all direct cost employees and any other Contractor employee who has other than a minimal impact or involvement in contract performance.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) The Contractor, if other than an individual, shall--within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;.

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction.

(5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

(i) Taking appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.

(d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

(End of clause)

55. OZONE-DEPLETING SUBSTANCES (JUN 1996) FAR 52.223-11

(a) *Definition*. "Ozone-depleting substance", as used in this clause, means any substance designated as Class I by the Environmental Protection Agency (EPA) (40 CFR Part 82), including but not limited to chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform; or any substance designated as Class II by EPA (40 CFR Part 82), including but not limited to hydrochlorofluorocarbons.

(b) The Contractor shall label products which contain or are manufactured with ozone-depleting substances in the manner and to the extent required by 42 U.S.C. 7671j (b), (c), and (d) and 40 CFR Part 82, Subpart E, as follows:

''WARNING: Contains (or manufactured with, if applicable) ____*_____, a substance(s) which harm(s) public health and environment by destroying ozone in the upper atmosphere."

*The Contractor shall insert the name of the substance(s).

(End of clause)

56. TOXIC CHEMICAL RELEASE REPORTING (OCT 1996) FAR 52.223-14

(a) Unless otherwise exempt, the Contractor , as owner or operator of a facility used in the performance of this contract, shall file by July 1 for the prior calendar year an annual Toxic Chemical Release Form (Form R) as described in sections 313(a) and (g) of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023(a) and (g)), and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106). The Contractor shall file, for each facility subject to the Form R filing and reporting requirements, the annual Form R throughout the life of the contract.

(b) A Contractor owned or operated facility used in the performance of this contract is exempt from the requirement to file an annual Form R if--

(1) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

(2) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023 (b)(1)(A);

(3) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been file with EPA);

(4) The facility does not fall within the Standard Industrial Classification Code (SIC) designations 20 through 39 as set forth in section 19.102 of the Federal Acquisition Regulation (FAR); or

(5) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(c) If the Contractor has certified to an exemption in accordance with one or more of the criteria in paragraph (b) of this clause, and after award of the contract circumstances change so that any one of its owned or operated facilities used in the performance of this contract is no longer exempt--

(1) The Contractor shall notify the Contracting Officer; and

(2) The Contractor as owner or operator of a facility used in the performance of this contract that is no longer exempt, shall (I) submit a Toxic Chemical Release Inventory Form (Form R) on or before July 1 for the prior calendar year during which the facility becomes eligible; and (ii) continue to file the annual Form R for the life of the contract for such facility.

(d) The Contracting Officer may terminate this contract or take other action as appropriate, if the Contractor fails to comply accurately and fully with the EPCRA and PPA toxic chemical release filing and reporting requirements.

(e) Except for acquisitions of commercial items as defined in FAR Part 2, the Contractor shall--

(1) For competitive subcontracts expected to exceed $100,000 (including all options), include a solicitation provision substantially the same as the provision at FAR 52.223-13, Certification of Toxic Chemical Release Reporting; and

(2) Include in any resultant subcontract exceeding $100,000 (including all options), the substance of this clause, except this paragraph (e).

(End of clause)

57. BUY AMERICAN ACT--CONSTRUCTION MATERIALS (JUN 1997) FAR 52.225-5

NOTE: This clause applies only to contracts less than $6,500,000.

(a) *Definitions*. As used in this clause--

The Buy American Act (41 U.S.C. 10) provides that the Government give preference to domestic construction material.

"Components" means those articles, materials, and supplies incorporated directly into construction materials.

"Construction material" means an article, material, or supply brought to the construction site for incorporation into the building or work. Construction material also includes an item brought to the site pre-assembled from articles, materials or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, which are discrete systems incorporated into a public building or work and which are produced as a complete system, shall be evaluated as a single and distinct construction material regardless of when or how the individual parts or components of such systems are delivered to the construction site.

"Domestic construction material" means (1) an unmanufactured construction material mined or produced in the United States, or (2) a construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind as the construction materials determined to be unavailable pursuant to subparagraph 25.202(a)(2) of the Federal Acquisition Regulation (FAR) shall be treated as domestic.

(b) (1) The Buy American Act (41 U.S.C. 10a-10d) requires that only domestic construction material be used in performing this contract, except as provided in paragraphs (b)(2) and (b)(3) of this clause.

(2) This requirement does not apply to the excepted construction material or components listed by the Government as follows: (List will appear in Section H if required.)

(3) Other foreign construction material may be added to the list in paragraph (b)(2) of this clause if the Government determines that--

(i) The cost would be unreasonable (the cost of a particular domestic construction material shall be determined to be unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent, unless the agency head determines a higher percentage to be appropriate);

(ii) The application of he restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(4) The Contractor agrees that only domestic construction material will be used by the Contractor, subcontractors, material men, and suppliers in the performance of this contract, except for foreign construction materials, if any, listed in paragraph (b)(2) of this clause.

(c) *Request for determination*. (1) Contractors requesting to use foreign construction material under paragraph (b)(3) of this clause shall provide adequate information for Government evaluation of the request for a determination regarding the inapplicability of the Buy American Act. Each submission shall include a description of the foreign and domestic construction materials, including unit of measure, quantity, price, time of delivery or availability, location of the construction project, name and address of the proposed contractor, and a detailed justification of the reason for use of foreign materials cited in accordance with paragraph (b)(3) of this clause. A submission based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause. The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(2) If the Government determines after contract award that an exception to the Buy American Act applies, the contract shall be modified to allow use of the foreign construction material, and adequate consideration shall be negotiated. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration shall not be less than the differential established in paragraph (b)(3)(i) of this clause.

(3) If the Government does not determine that an exception of the Buy American Act applies, the use of that particular foreign construction material will be a failure to comply with the Act.

(d) For evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the following information any applicable supporting data based on the survey of suppliers shall be included in the request:

FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON

Construction material description	Unit of measure	Quantity	Price (dollars) *
Item 1:			
Foreign construction material			
Domestic construction material			
Item 2:			
Foreign construction material			
Domestic construction material			

List name, address, telephone number, and contract for suppliers surveyed. Attach copy of response; if oral, attach summary. Include other applicable supporting information.

*Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued.

(End of clause)

58. RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (AUG 1998) FAR 52.225-11

(a) Unless advance written approval of the Contracting Officer is obtained, the Contractor shall not acquire for use in the performance of this contract, any supplies or services originating from sources within, or that were located in or transported from or through, countries whose products are banned from importation into the United States by Executive order or regulations of the Office of Foreign Assets Control, Department of the Treasury. Those countries include Cuba, Iran, Iraq, Libya, and North Korea, and Sudan.

(b) The Contractor shall not acquire for use in the performance of this contract any supplies or services from entities controlled by the Government of Iraq.

(c) The Contractor agrees to insert the provisions of this clause, including this paragraph (c), in all subcontracts hereunder.

(End of clause)

59. BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS ACT AND NORTH AMERICAN FREE TRADE AGREEMENT (JUN 1997) FAR 52.225-15

NOTE: This clause applies only to acquisitions with an acquisition value of $7,311,000 or more.

(a) *Definitions*. As used in the clause--

"Components" means those articles, materials, and supplies incorporate directly into construction materials.

"Construction material" means an article, material, or supply brought to the construction site for incorporation into the building or work. Construction material also includes an item brought to the site pre-assembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, which are discrete systems incorporated into a public building or work and which are produced as a complete system, shall be evaluated as a single and distinct construction material regardless of when or how the individual parts or components of such systems are delivered to the construction site.

"Designated country construction material" means a construction material that (a) is wholly the growth, product, or manufacture of a designated country (as defined at FAR 25.401), or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

"Domestic construction material" means (1) an unmanufactured construction material mined or produced in the United States, or (2) a construction material manufactured in the U.S., if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind as the construction materials determined to be unavailable pursuant to subparagraph 25.202(a)(2) of the Federal Acquisition Regulation (FAR) shall be treated as domestic.

"North American Free Trade Agreement (NAFTA) country" means Canada or Mexico.

"NAFTA country construction material" means a construction material that (a) is wholly the growth, product, or manufacture of a NAFTA country, or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a NAFTA country into a new and different construction material distinct from the materials from which it was transformed.

(b) (1) The Buy American Act (41 U.S.C. 10a-10d) requires that only domestic construction material be used in performing this contract, except as provided in paragraphs (b)(2), (b)(3), and (b)(4) of this clause.

(2) The Trade Agreements Act and the North American Free Trade Agreement (NAFTA) provide that designated country and NAFTA country construction materials are exempted from application of the Buy American Act.

(3) The requirement in paragraph (b)(1) of this clause does not apply to the excepted construction material or components listed by the Government as follows:
(See Section 00800)

(4) Other foreign construction material may be added to the list in paragraph (b)(3) of this clause if the Government determines that--

(i) The cost would be unreasonable (the cost of a particular domestic construction material shall be determined to be unreasonable when the cost of such material exceeds the cost of foreign material exceeds the cost of foreign material by more than 6 percent, unless the agency head determines a higher percentage to be appropriate);

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(5) The Contractor agrees that only domestic construction materials, NAFTA country construction materials, or designated country construction materials will be used by the Contractor, subcontractors, material men, and suppliers in the performance of this contract, except for foreign construction materials if any, listed in paragraph (b)(3) of this clause.

(c) *Request for* determination. (1) Contractors requesting to use foreign construction material under paragraph (b)(4) of this clause shall provide adequate information for Government evaluation of the request for a determination regarding the inapplicability of the Buy American Act. Each submission shall include a description of the foreign and domestic construction materials, including unit of measure, quantity, price, time of delivery or availability, location of the construction project, name and address of the proposed contractor, and a detailed justification of the reason for use of foreign materials cited in accordance with paragraph (b)(4) of this clause. A submission based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause. The price of construction materials shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(2) If the Government determines after contract award that an exception to the Buy American Act applies, the contract shall be modified to allow use of the foreign construction material, and adequate consideration all be negotiated. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration all not be less than the differential established in paragraph (b)(4)(i) of this clause.

(3) If the Government does not determine that an exception to the Buy American Act applies, the use of that particular foreign construction material will be a failure to comply with the Act.

(d) For evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the following information and any applicable supporting data based on the survey of suppliers shall be included in the request:

FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON

Construction material description	Unit of measure	Quantity	Price (dollars) *
Item 1:			
Foreign construction material			
Domestic construction material			
Item 2:			
Foreign construction material			
Domestic construction material			

List name, address, telephone number, and contract for suppliers surveyed. Attach copy of response; if oral, attach summary. Include other applicable supporting information.

*Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate is issued).

(End of clause)

60. BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS ACT AND NORTH AMERICAN FREE TRADE AGREEMENT (MAY 1997) ALTERNATE I (MAY 1997) FAR 52.225-15 I

NOTE: This clause applies only to acquisitions with an acquisition value from $6,500,000 to $7,311,000.

(a) *Definitions*. As used in the clause--

"Components" means those articles, materials, and supplies incorporate directly into construction materials.

"Construction material" means an article, material, or supply brought to the construction site for incorporation into the building or work. Construction material also includes an item brought to the site pre-assembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, which are discrete systems incorporated into a public building or work and which are produced as a complete system, shall be evaluated as a single and distinct construction material regardless of when or how the individual parts or components of such systems are delivered to the construction site.

"Designated country construction material" means a construction material that (a) is wholly the growth, product, or manufacture of a designated country (as defined at FAR 25.401), or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

"Domestic construction material" means (1) an unmanufactured construction material mined or produced in the United States, or (2) a construction material manufactured in the U.S., if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind as the construction materials determined to be unavailable pursuant to subparagraph 25.202(a)(2) of the Federal Acquisition Regulation (FAR) shall be treated as domestic.

"North American Free Trade Agreement (NAFTA) country" means Canada or Mexico.

"NAFTA country construction material" means a construction material that (a) is wholly the growth, product, or manufacture of a NAFTA country, or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a NAFTA country into a new and different construction material distinct from the materials from which it was transformed.

(b) (1) The Buy American Act (41 U.S.C. 10a-10d) requires that only domestic construction material be used in performing this contract, except as provided in paragraphs (b)(2), (b)(3), and (b)(4) of this clause.

(2) The North American Free Trade Agreement (NAFTA) provides that NAFTA construction materials are exempted from application of the Buy American Act.

(3) The requirement in paragraph (b)(1) of this clause does not apply to the excepted construction material or components listed by the Government as follows:

(See Section H)

(4) Other foreign construction material may be added to the list in paragraph (b)(3) of this clause if the Government determines that--

(i) The cost would be unreasonable (the cost of a particular domestic construction material shall be determined to be unreasonable when the cost of such material exceeds the cost of foreign material exceeds the cost of foreign material by more than 6 percent, unless the agency head determines a higher percentage to be appropriate);

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(5) The Contractor agrees that only domestic construction materials, or NAFTA country construction materials, will be used by the Contractor, subcontractors, material men, and suppliers in the performance of this contract, except for foreign construction materials, if any, listed in paragraph (b)(3) of this clause.

(c) *Request for* determination. (1) Contractors requesting to use foreign construction material under paragraph (b)(4) of this clause shall provide adequate information for Government evaluation of the request for a determination regarding the inapplicability of the Buy American Act. Each submission shall include a description of the foreign and domestic construction materials, including unit of measure, quantity, price, time of delivery or availability, location of the

construction project, name and address of the proposed contractor, and a detailed justification of the reason for use of foreign materials cited in accordance with paragraph (b)(4) of this clause. A submission based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause. The price of construction materials shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(2) If the Government determines after contract award that an exception to the Buy American Act applies, the contract shall be modified to allow use of the foreign construction material, and adequate consideration all be negotiated. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration all not be less than the differential established in paragraph (b)(4)(i) of this clause.

(3) If the Government does not determine that an exception to the Buy American Act applies, the use of that particular foreign construction material will be a failure to comply with the Act.

(d) For evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the following information and any applicable supporting data based on the survey of suppliers shall be included in the request:

FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON

Construction material description	Unit of measure	Quantity	Price (dollars) *
Item 1:			
Foreign construction material			
Domestic construction material			
Item 2:			
Foreign construction material			
Domestic construction material			

List name, address, telephone number, and contract for suppliers surveyed. Attach copy of response; if oral, attach summary. Include other applicable supporting information.

*Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate is issued).

(End of clause)

61. SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992) DFARS 252.225-7031

(a) *Definitions*. As used in this clause--

(1) "Foreign person" means any person other than a United States person as defined in Section 16(2) of the Export Administration Act of 1979 (50 U.S.C. App. Sec 2415).

(2) "United States person" is defined in Section 16(2) of the Export Administration Act of 1979 and means any United States resident or national (other than an individual resident outside the United States and employed by other than a United States person), any domestic concern (including any permanent domestic establishment of any foreign concern), and any foreign concern), and any foreign subsidiary or affiliate (including any permanent foreign establishment) of any domestic concern which is controlled in fact by such domestic concern, as determined under regulations of the President.

(b) *Certification*. By submitting this offer, the Offeror, if a foreign person, company or entity, certifies that it--

(1) Does not comply with the Secondary Arab Boycott of Israel; and

(2) Is not taking or knowingly agreeing to take any action, with respect to the Secondary Boycott of Israel of Arab countries, which 50 U.S.C. App. Sec. 2407(a) prohibits a United States person from taking.

(End of clause)

62. UTILIZATION OF INDIAN ORGANIZATIONS AND INDIAN-OWNED ECONOMIC ENTERPRISES (SEP 1996) FAR 52.226-1

(a) For Department of Defense contracts, this clause applies only if the contract includes a subcontracting plan incorporated under the terms of the clause at FAR 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan. It does not apply to contracts awarded based on a subcontracting plan submitted and approved under paragraph (g) of the clause at 52.219-9.

(b) *Definitions*. As used in this clause:

"Indian" means any person who is a member of any Indian tribe, band, group, pueblo, or community which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs (BIA) in accordance with 25 U.S.C. 1452(c) and any "Native" as defined in the Alaska Native Claims Settlement Act (43 U.S.C. 1601).

"Indian-organization" means the governing body of any Indian tribe or entity established or recognized by the governing body of an Indiana tribe for the purposes of 25 U.S.C., chapter 17.

"Indian-owned economic enterprise" means any Indian-owned (as determined by the Secretary of the Interior) commercial, industrial, or business activity established or organized for the purpose of profit, provided that Indian ownership shall constitute not less than 51 percent of the enterprise.

"Indian tribe" means any Indian tribe, band, group, pueblo, or community, including native villages and native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, which is recognized by the Federal Government as eligible for services from BIA in accordance with 25 U.S.C. 1452(c).

"Interested party" means a prime contractor or an actual or prospective offeror whose direct economic interest would be affected by the award of a subcontract or by the failure to award a subcontract.

(c) The Contractor agrees to use its best efforts to give Indian organizations and Indian-owned economic enterprises (25 U.S.C. 1544) the maximum practicable opportunity to participate in the subcontracts it awards to the fullest extent consistent with efficient performance of its contract.

(1) The Contracting Officer and the Contractor, acting in good faith, may rely on the self-certification of an Indian organization or Indian-owned economic enterprise as to its eligibility, unless an interested party challenges its status or the Contracting Officer has independent reason to question that status. In the event of a challenge to the self-certification of a subcontractor, the Contracting Officer shall refer the matter to the U.S. Department of the Interior, Bureau of Indian Affairs (BIA), Attn: Chief, Division of Contracting and Grants Administration, 1849 C Street, NW, MS-334A-SIB, Washington, DC 20245. The BIA will determine the eligibility and notify the Contracting Officer. The 5 percent incentive payment will not be made within 50 workings days of subcontract award or while a challenge is pending. If a subcontractor is determined to be an ineligible participant, no incentive payment will be made under the Indian Incentive Program.

(2) The Contractor may request an adjustment under the Indian Incentive Program to the following:

(i) The estimated cost of a cost-type contract;

(ii) The target cost of a cost-plus-incentive-fee prime contract;

(iii) The target cost and ceiling price of a fixed price incentive prime contract.

(iv) The price of a firm-fixed-price prime contract.

(3) The amount of the equitable adjustment to the prime contract shall be 5 percent of the estimated cost, target cost, or firm-fixed-price included in the subcontract initially awarded to the Indian organization or Indian-owned economic enterprise.

(4) The Contractor has the burden of proving the amount claimed and must assert its request for an adjustment prior to completion of contract performance.

(d) The Contracting Officer, subject to the terms and conditions of the contract and the availability of funds, shall authorize an incentive payment of 5 percent of the amount paid to the subcontractor. The Contracting Officer shall seek funding in accordance with agency procedures. The Contracting Officer's decision is final and not subject to the Dispute clause of this contract.

(End of clause)

63. AUTHORIZATION AND CONSENT (JUL 1995) FAR 52.227-1

(a) The Government authorizes and consents to all use and manufacture, in performing any contract or any subcontract at any tier, of any invention described in and covered by a United States patent (1) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract or (2) used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with (i) specifications or written provisions forming a part of this contract or (ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clause, if any, included in this contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

(b) The Contractor agrees to include, and require inclusion of, this clause, suitably modified to identify the parties, in all subcontracts at any tier for supplies or services (including construction, architect-engineer services, and materials, supplies, models, samples, and design or testing services expected to exceed the simplified acquisition threshold);

however, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, does not affect this authorization and consent.

(End of clause)

64. PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984) FAR 52.227-4

Except as otherwise provided, the Contractor agrees to indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.

(End of clause)

65. RIGHTS IN SHOP DRAWINGS (APR 1966) DFARS 252.227-7033

(a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail(i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.

(End of clause)

66. ADDITIONAL BOND SECURITY (OCT 1997) FAR 52.228-2

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying labor or materials under this contract if--

(a) Any surety upon any bond, or issuing financial institution for other security, furnished with this contract becomes unacceptable to the Government;

(b) Any surety fails to furnish reports on its financial condition as required by the Government;

(c) The contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer; or

(d) An irrevocable letter of credit (ILC) used as security will expire before the end of the period of required security. If the Contractor does not furnish an acceptable extension or replacement ILC, or other acceptable substitute, at least 30 days before an ILC's scheduled expiration, the Contracting Officer has the right to immediately draw on the ILC.

(End of clause)

67. INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997) FAR 52.228-5

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract, at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(b) Before commencing work under this contract, the Contractor shall notify the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribed or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

(End of clause)

68. PLEDGES OF ASSETS (FEB 1992) FAR 52.228-11

(a) Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond--

(1) Pledge of assets; and

(2) Standard Form 28, Affidavit of Individual Surety.

(b) Pledges of assets from each person acting as an individual surety shall be in the form of--

(1) Evidence of an escrow account containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government securities held in book entry form) and/or;

(2) A recorded lien on real estate. The offeror will be required to provide--

(i) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice. This title evidence must show fee simple title vested in the surety along with any concurrent owner; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(ii) Evidence of the amount due under any encumbrance shown in the evidence of title;

(iii) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

(End of clause)

69. PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (OCT 1995) FAR 52.228-12

In accordance with Section 806(a)(3) of Pub. L. 102-190, as amended by Sections 2091 and 8105 of Pub. L. 103-355, upon the request of a prospective subcontractor or supplier offering to furnish labor or material for the performance of this contract for which a payment bond has been furnished to the Government pursuant to the Miller Act, the Contractor shall promptly provide a copy of such payment bond to the requester.

(End of clause)

70. FEDERAL, STATE, AND LOCAL TAXES (JAN 1991) FAR 52.229-3

(a) "Contract date," as used in this clause, means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification

"All applicable Federal, State, and local taxes and duties," as used in this clause, means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"After-imposed Federal tax," as used in this clause, means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative, judicial, or administrative action taking effect after the contract date. It does not include social security tax or other employment taxes.

"After-relieved Federal tax," as used in this clause, means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable, on the transactions or property covered by this contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

(b) The contract price includes all applicable Federal, State, and local taxes and duties.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of any after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceed $250.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption.

(End of clause)

71. SUPPLEMENTAL COST PRINCIPLES (DEC 1991) DFARS 52.231-7000

When the allowability of costs under this contract is determined in accordance with Part 31 of the Federal Acquisition Regulation (FAR), allowability shall also be determined in accordance with Part 231 of the Defense FAR Supplement, in effect on the date of this contract.

(End of clause)

72. PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997) FAR 52.232-5

(a) *Payment of price*. The Government shall pay the Contractor the contract price as provided in this contract.

(b) *Progress payments*. The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the amount included for work performed by each subcontract under the contract.

(iv) A listing of the amounts previously paid to each such subcontractor under the contract.

(v) Additional supporting data in a form and detail required by the Contracting Officer.

(2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if--

(i) Consideration is specifically authorized by this contract; and

(ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) *Contractor certification*. Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.)

I hereby certify, to the best of my knowledge and belief, that--

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) Payments to subcontractors and suppliers have been made from previous payments received under the contract, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code; and

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and

(4) This certification is not to be construed as final acceptance of a subcontractor's performance.

_____

(Name)

_____

(Title)

_____

(Date)

(d) *Refund of unearned amounts*. If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall--

(1) Notify the Contracting Officer of such performance deficiency; and

(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the date of receipt of the unearned amount until--

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) *Retainage*. If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) *Title, liability, and reservation of rights*. All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) *Reimbursement for bond premiums*. In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) *Final payment*. The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) *Limitation because of undefinitized work*. Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) *Interest computation on unearned accounts*. In accordance with 31 U.S.C. 3903(c)(1), the amount payable under subparagraph (d)(2) of this clause shall be--

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

(End of clause)

73. INTEREST (JUNE 1996) FAR 52.232-17

(a) Except as otherwise provided in this contract under a Price Reduction for Defective Cost or Pricing Data clause or a Cost Accounting Standards clause, all amounts that become payable by the Contractor to the Government under this contract (net of any applicable tax credit under the Internal Revenue Code (26 U.S.C. 1481)) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate

established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid.

(b) Amounts shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination.

(3) The date the Government transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt.

(4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification.

(c) The interest charge made under this clause may be reduced under the procedures prescribed in 32.614-2 of the Federal Acquisition Regulation in effect on the date of this contract.

(End of clause)

74. ASSIGNMENT OF CLAIMS (JAN 1986) ALTERNATE I (APR 1984) FAR 52.232-23 I

(a) The Contractor, under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 15 (hereafter referred to as "the Act"), may assign it rights to be paid amounts due or to become due as a result of the performance of this contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such an assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence. Unless otherwise stated in this contract, payments to an assignee of any amounts due or to become due under this contract shall not, to the extent specified in the Act, be subject to reduction or setoff.

(b) Any assignment or reassignment authorized under the Act and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.

(End of clause)

75. PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (JUN 1997) FAR 52.232-27

Notwithstanding any other payment terms in this contract, the Government will make invoice payments and contract financing payments under the terms and conditions specified in this clause. Payment shall be considered as being made on the day a check is dated or an electronic funds transfer. Definitions of pertinent terms are set forth in 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see subparagraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) *Invoice Payments*--(1) *Types of invoice payments.* For purposes of this clause, there are several types of invoice payments which may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project:

(A) The due date for making such payments shall be 14 days after receipt of the payment request by the designated billing office. However, if the designated billing office fails to annotate the payment request with the actual date of receipt at the time of receipt, the payment due date shall be the 14th day after the date of the Contractor's payment request, provided a proper payment request is received and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, shall be as specified in the contract or, if not specified 30 days after approval for release to the Contractor by the Contracting Officer.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the

Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract):

(A) The due date for making such payments shall be either the 30th day after receipt by the designated billing office of a proper invoice from the Contractor, or the 30th day after Government acceptance of the work or services completed by the Contractor, whichever is later. If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date shall be deemed to be the 30th day after the date the Contractor's invoice, provided a proper invoice is received and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) On a final invoice where the payment amount is subject to contract settlement actions (e.g., release of claims), acceptance shall be deemed to have occurred on the effective date of the contract settlement.

(2) *Contractor's invoice.* The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(ix) of this clause. If the invoice does not comply with these requirements, it shall be returned within 7 days after the date the designated billing office received the invoice, with a statement of the reasons why it is not a property invoice. Untimely notification will be taken into account in computing any interest penalty owed the Contractor in the manner described in subparagraph (a)(4) of this clause.

(i) Name and address of the Contractor

(ii) Invoice date. (The Contractor is encouraged to date invoices as close as possible to the date of mailing or transmission.)

(iii) Contract number or other authorization for work or services performed (including order number and contract line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (e.g., prompt payment discount terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to be notified in event of a defective invoice.

(viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.

(ix) Any other information or documentation required by the contract.

(x) While not required, the Contractor is strongly encouraged to assign an identification number to each invoice.

(3) *Interest penalty.* An interest penalty shall be paid automatically by the designated payment office, without request from the Contractor, if payment is not made by the due date and the conditions listed in subdivisions (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday when Federal Government offices are closed and Government business is not expected to be conducted, payment will be made on the following business day without incurring a late payment interest penalty.

(i) A proper invoice was received by the designated billing office.

(ii) A receiving report or other Government documentation authorizing payment was processed and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) *Computing penalty amount.* The interest penalty shall be at the rate established by the Secretary of the Treasury under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) that is in effect on the day after the due date, except where the interest penalty is prescribed by other governmental authority (e.g., tariffs). This rate is referred to as the "Renegotiation Board Interest Rate," and it is published in the *Federal Register* semiannually on or about January 1 and July 1. The interest penalty shall accrue daily on the invoice principal payment amount approved by the Government until the payment date of such approved principal amount, and will be compounded in 30-day increments inclusive from the first day after the due date through the payment date. That is, interest accrued at the end of any 30-day period will be added to the approved invoice principal payment amount and be subject to interest penalties if not paid in the succeeding 30-day period. If the designated billing office failed to notify the Contractor of a defective invoice within the periods

prescribed in subparagraph (a)(2) of this clause, the due date on the corrected invoice will be adjusted by subtracting the number of days taken beyond the prescribed notification of defects period. Any interest penalty owed the Contractor will be based on this adjusted due date. Adjustments will be made by the designated payment office for errors in calculating interest penalties.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in subdivision (a)(1)(ii) of this clause, Government acceptance or approval shall be deemed to have occurred constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. In the event that actual acceptance or approval occurs within the constructive acceptance or approval period the determination of an interest penalty shall be based on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The following periods of the time will not be included in the determination of an interest penalty:

(A) The period taken to notify the Contractor of defects in invoices submitted to the Government, but this may not exceed 7 days.

(B) The period between the defects notice and resubmission of the corrected invoice by the Contractor.

(C) For incorrect electronic funds transfer (EFT) information, in accordance with the EFT clause of this contract

(iii) Interest penalties will not continue to accrue after the filing of a claim for such penalties under the clause at 52.233-1, Disputes, or for more than 1 year. Interest penalties of less than $1.00 need not be paid.

(iv) Interest penalties are not required on payment delays due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. Claims involving disputes, and any interest that may be payable, will be resolved in accordance with the clause at 52.233-1, Disputes.

(5) *Prompt payment discounts.* An interest penalty shall also be paid automatically by the designated payment office, without request from the Contractor, if a discount for prompt payment is taken improperly. The interest penalty will be calculated on the amount of discount taken for the period beginning with the first day after the end of the discount period through the date when the Contractor is paid.

(6) *Additional interest penalty.* (i) If this contract was awarded on or after October 1, 1989, a penalty amount, calculated in accordance with subdivision (a)(6)(iii) of this clause, shall be paid in addition to the interest penalty amount if the Contractor--

(A) Is owed an interest penalty of $1 or more;

(B) Is not paid the interest penalty within 10 days after the date the invoice amount is paid; and

(C) Makes a written demand to the designated payment office for additional penalty payment, in accordance with subdivision (a)(6)(ii) of this clause, postmarked not later than 40 days after the date the invoice amount is paid.

(ii) (A) Contractors shall support written demands for additional penalty payments with the following data. No additional data shall be required. Contractors shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) Demands may be postmarked on or before the 40th day after payment was made, except that--

(1) If the postmarked is illegible or nonexistent, the demand must have been received and annotated with the date of receipt by the designated payment office on or before the 40th day after payment was made; or

(2) If the postmark is illegible or nonexistent and the designated payment office fails to make the required annotation, the demand's validity will be determined by the date the Contractor has placed on the demand; provided such date is no later than the 40th day after payment was made.

(iii) (A) The additional penalty shall be equal to 100 percent of any original late payment, except--

(1) The additional penalty shall not exceed $5,000;

(2) The additional penalty shall never be less than $25; and

(3) No additional penalty is owed if the amount of the underlying interest penalty is less than $1.

(B) If the interest penalty ceases to accrue in accordance with the limits stated in subdivision (a)(4)(iii) of this clause, the amount of the additional penalty shall be calculated on the amount of interest penalty that would have accrue in the absence of these limits, subject to the overall limits on the additional penalty specified in subdivision (a)(6)(iii)(a) of the clause.

(C) For determining the maximum and minimum additional penalties, the test shall be the interest penalty due on each separate payment made for each separate contract. The maximum and minimum additional penalty shall not be based upon individual invoices unless the invoices are paid separately. Where payments are consolidated for disbursing purposes, the maximum and minimum additional penalty determination shall be made separately for each contract therein.

(D) The additional penalty does not apply to payments regulated by other Government regulations (e.g., payments under utility contracts subject to tariffs and regulation).

(b) *Contract Financing Payments*. (1) *Due dates for recurring financing payments.* If this contract provides for contract financing, requests for payment shall be submitted to the designated billing office as specified in this contract or as directed by the Contracting Officer. Contract financing payment shall be made on the 30th day after receipt of a proper contract financing request by the designated billing office. In the event that an audit or other review of a specific financing request is required to ensure compliance with the terms and conditions of the contract, the designated payment office is not compelled to make payment by the due date specified.

(2) *Due dates for other contract financing.* For advance payments, loans, or other arrangements that do not involve recurring submissions of contract financing requests, payment shall be made in accordance with the corresponding contract terms or as directed by the Contracting Officer.

(3) *Interest penalty not applicable.* Contract financing payments shall not be assessed an interest penalty for payment delays.

(c) *Subcontract clause requirements.* The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) *Prompt payment for subcontractors.* A payment clause which obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) *Interest for subcontractors.* An interest penalty clause which obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due to made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the *Federal Register*, for interest payments under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligations to pay an interest penalty.

(3) *Subcontract clause flowdown* A clause requiring each subcontractor to include a payment clause and an interest penalty clause conforming to the standards set forth in subparagraphs (c)(1) and (c)(2) of this clause in each of its subcontracts, and to require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) *Subcontract clause interpretation.* The clauses required by paragraph (c) of this clause shall not be construed to impair the right of Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that--

(1) *Retainage permitted.* Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and payment bond;

(2) *Withholding permitted.* Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) *Withholding requirements.* Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) A copy of any notice issued by a Contractor pursuant to subdivision (d)(3)(i) of this clause has been furnished to the Contracting Officer.

(e) *Subcontractor withholding procedures*. If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) *Subcontractor notice*. Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) *Contracting Officer notice.* Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to subparagraph (e)(1) of this clause;

(3) *Subcontractor progress payment reduction.* Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under subparagraph (e)(1) of this clause;

(4) *Subsequent subcontractor payment.* Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under subdivision (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the *Federal Register*, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) *Notice to Contracting Officer*. Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under subparagraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) *Interest to Government.* Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under subdivision (e)(5)(i) of this clause.

(f) *Third-party deficiency reports.* (1) *Withholding from subcontractor*. If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a "second-tier subcontractor") a written notice in accordance with section 2 of the Act of August 24, 1935 (40 U.S.C. 270b, Miller Act), asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under subparagraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) *Subsequent payment or interest charge.* As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall (i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or (ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the *Federal Register*, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) *Written notice of subcontractor withholding.* A written notice of any withholding shall be issued to a subcontractor (with a copy to the Contracting Officer of any such notice issued by the Contractor), specifying--

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) *Subcontractor payment entitlement.* The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) *Prime-subcontractor disputes.* A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the United States is a party. The United States may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) *Preservation of prime-subcontractor rights.* Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) *Non-recourse for prime contractor interest penalty.* The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the United States for such interest penalty. A cost reimbursement claim may not include any amount for reimbursement of such interest penalty.

(End of clause)

76. PAYMENT BY ELECTRONIC FUNDS TRANSFER (CCR) (JUN 1998)
DFARS 252.232-7009

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) or (b) of this clause. As used in this clause, the term "EFT" refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either (i) accept payment by check or some other mutually agreeable method of payment, or (ii) request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (e) of this clause).

(b) Alternative contractor certification. If the Contractor certifies in writing, as part of its registration with the Central Contractor Registration (CCR) database that it does not have an account with a financial institution and does not have an authorized payment agent, payment shall be made by check to the remittance address contained in the CCR database. All contractor certifications will expire on January 1, 1999.

(c) Contractor's EFT information. Except as provided in paragraph (b) of this clause, the Government shall make payment to the Contractor using the EFT information contained in the CCR database. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the CCR database.

(d) Mechanisms for EFT payment. The Government may make payment by EFT through either an Automated Clearing House subject to the banking laws of the United States or the Federal Reserve Wire Transfer System.

(e) Suspension of payment. If the Contractor's EFT information in the CCR database is incorrect and the Contractor has not certified under paragraph (b) of this clause, the Government need not make payment to the Contractor under this contract until correct EFT information or certification is entered into the CCR database; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(f) Contractor EFT arrangements. If the Contractor has identified multiple payment receiving points (i.e., more than one remittance address or EFT information set) in the CCR database, and the Contractor has not notified the Government of the payment receiving point applicable to this contract, the Government shall make payment to the first payment receiving point (EFT information set or remittance address as applicable) listed in the CCR database.

(g) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government failed to use the Contracto5r's EFT information in the correct manner, the Government remains responsible for—

(i) Making a correct payment;

(ii) Paying any prompt payment penalty due; and

(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and—

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (e) of this clause shall apply.

(h) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(i) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee register in the CCR database and be paid by EFT in accordance with the terms of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (e) of this clause.

(j) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(k) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Contractor has certified in accordance with paragraph (b) of this clause or if the Government otherwise make payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in the CCR database.

(End of clause)

77. DISPUTES (OCT 1995) FAR 52.233-1

(a) This contract is subject to the Contract Disputes Act of 1978, as amended (41 U.S.C. 601-613).

(b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved under this clause.

(c) "Claim," as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding $100,000 is not a claim under the Act until certified as required by subparagraph (d)(2) of this clause. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under the Act. The submission may be converted to a claim under the Act, by complying with the submission and certification requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d)(1) A claim by the Contractor shall be made in writing and, unless otherwise stated in this contract, submitted within 6 years after accrual of the claim to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.

(2)(i) Contractors shall provide the certification specified in subparagraph (d)(2)(iii) of this clause when submitting any claim--

(A) Exceeding $100,000; or

(B) Regardless of the amount claimed, when using--

(1) Arbitration conducted pursuant to 5 U.S.C. 575-580; or

(2) Any other alternative means of dispute resolution (ADR) technique that the agency elects to handle in accordance with the Administrative Dispute Resolution Act (ADRA).

(ii) The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim.

(iii) The certification shall state as follows: "I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable; and that I am duly authorized to certify the claim on behalf of the Contractor."

(3) The certification may be executed by any person duly authorized to bind the Contractor with respect to the claim.

(e) For Contractor claims of $100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claims over $100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.

(f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in the Act.

(g) If the claim by the Contractor is submitted to the Contracting Officer or a claim by the Government is presented to the Contractor, the parties, by mutual consent, may agree to use ADR. If the Contractor refuses an offer for alternative disputes resolution, the Contractor shall inform the Contracting Officer, in writing, of the Contractor's specific reasons for rejecting the request. When using arbitration conducted pursuant to 5 U.S.C. 575-580, or when using any other ADR technique that the agency elects to handle in accordance with the ADRA, any claim, regardless of amount, shall be accompanied by the certification described in subparagraph (d)(2)(iii) of this clause, and executed in accordance with subparagraph (d)(3) of this clause.

(h) The government shall pay interest on the amount found due and unpaid from (1) the date that the Contracting Officer receives the claim (certified, if required); or (2) the date that payment otherwise would be due, if that date is later, until the date of payment. With regard to claims having defective certification, as defined in FAR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claim shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the Contracting Officer.

(End of clause)

78. PROTEST AFTER AWARD (AUG 1996) FAR 52.233-3

(a) Upon receipt of a notice of protest (as defined in FAR 33.101) or a determination that a protest is likely (see FAR 33.102(d)), the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage; *provided*, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal submitted at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.

(f) If, as the result of the Contractor's intentional or negligent misstatement, misrepresentation, or miscertification, a protest related to this contract is sustained, and the Government pays costs, as provided in FAR 33.102(b)(2) or 33.104(h)(1), the Government may require the Contractor to reimburse the Government the amount of such costs. In addition to any other remedy available, and pursuant to the requirements of Subpart 32.6, the Government may collect this debt by offsetting the amount against any payment due the Contractor under any contract between the Contractor and the Government.

(End of clause)

79. DIFFERING SITE CONDITIONS (APR 1984) FAR 52.236-2

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of (1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; *provided*, that the time prescribed in paragraph (a) of this clause for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

(End of clause)

80. SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984) FAR 52.236-3

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as to this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any understanding reached or representation made concerning conditions that can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

(End of clause)

81. MATERIAL AND WORKMANSHIP (APR 1984) FAR 52.236-5

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide all information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping at the Contractor's expense, with all shipping charges prepaid. Machinery,

equipment, material, and articles that to not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

(End of clause)

82. SUPERINTENDENCE BY THE CONTRACTOR (APR 1984) FAR 52.236-6

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

(End of clause)

83. PERMITS AND RESPONSIBILITIES (NOV 1991) FAR 52.236-7

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

(End of clause)

84. OTHER CONTRACTS (APR 1984) FAR 52.236-8

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by Government employees.

(End of clause)

85. PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984) FAR 52.236-9

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities (1) at or near the work site, and (2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(End of clause)

86. OPERATIONS AND STORAGE AREAS (APR 1984) FAR 52.236-10

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(End of clause)

87. USE AND POSSESSION PRIOR TO COMPLETION (APR 1984) FAR 52.236-11

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use, notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

(End of clause)

88. CLEANING UP (APR 1984) FAR 52.236-12

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon completing the work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.

(End of clause)

89. ACCIDENT PREVENTION (NOV 1991)--ALTERNATE I (NOV 1991) FAR 52.236-13 I

(a) The Contractor shall provide and maintain work environments and procedures which will (1) safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities; (2) avoid interruptions of Government operations and delays in project completion dates; and (3) control costs in the performance of this contract.

(b) For these purposes on contracts for construction or dismantling, demolition, or removal of improvements, the Contractor shall--

(1) Provide appropriate safety barricades, signs, and signal lights;

(2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and

(3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for the purposes are taken.

(c) If this contract is for construction or dismantling, demolition or removal of improvements with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation.

(d) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Government personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient

notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.

(e) The Contractor shall insert this clause, including this paragraph (e), with appropriate changes in the designation of the parties, in subcontracts.

(f) Before commencing the work, the Contractor shall--

(1) Submit a written proposed plan for implementing this clause. The plan shall include an analysis of the significant hazards to life, limb, and property inherent in contract work performance and a plan for controlling these hazards; and

(2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

(End of clause)

90. SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984) FAR 52.236-15

(a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payment until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as directed by the Contracting Officer, and upon doing so shall immediately delivery three copies of the annotated schedule to the Contracting Officer. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

(End of clause)

91. SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)
FAR 52.236-21

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by," or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where “as shown”, “as indicated”, “as detailed”, or words of similar import are used, it shall be understood that reference is made to the drawings accompanying this contract unless stated otherwise. The word “provided” as used herein shall be understood to mean “provide complete in place”, that is furnished and installed”.

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, or any lower tier subcontractor pursuant to a construction contract, showing in detail (1) the proposed fabrication and assembly of structural elements and (2) the installation (i.e., fit, and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the contractor to explain in detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor’s approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government’s reasons therefor. Any work done before such approval shall be at the Contractor’s risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor.

(End of clause)

92. PRECONSTRUCTION CONFERENCE (FEB 1995) FAR 52.236-26

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer’s notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

(End of clause)

93. MODIFICATION PROPOSALS--PRICE BREAKDOWN (DEC 1991)
DFARS 252.236-7000

(a) The Contractor shall furnish a price breakdown, itemized as required and within the time specified by the Contracting Officer, with any proposal for a contract modification.

(b) The price breakdown--

(1) Must include sufficient detail to permit analysis of profit, and of all costs for--

(i) Material;

(ii) Labor;

(iii) Equipment;

(iv) Subcontracts; and

(v) Overhead; and

(2) Must cover all work involved in the modification, whether the work was deleted, added, or changed.

(c) The Contractor shall provide similar price breakdowns to support any amounts claimed for subcontracts.

(d) The Contractor’s proposal shall include a justification for any time extension proposed.

(End of clause)

94. BANKRUPTCY (JUL 1995) FAR 52.242-13

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish, by certified mail or electronic commerce method authorized by the contract, written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall

be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identity of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting offices for all Government contracts against which final payment has not been made. This obligation remains in effect until final payment under this contract.

(End of clause)

95. SUSPENSION OF WORK (APR 1984) FAR 52.242-14

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract.

(c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

(End of clause)

96. POSTAWARD CONFERENCE (DEC 1991) DFARS 252.242-7000

The Contractor agrees to attend any postaward conference convened by the contracting activity or contract administration office in accordance with Federal Acquisition Regulation Subpart 42.5.

(End of clause)

97. CHANGES (AUG 1987) FAR 52.243-4

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

(1) In the specifications (including drawings and designs);
(2) In the method or manner or performance of the work;
(3) In the Government-furnished facilities, equipment, materials, services, or site; or
(4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; *provided*, that the Contractor gives the Contracting Officer written notice stating (1) the date, circumstances, and source of the order and (2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after (1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of proposal, unless

this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

(End of clause)

98. PRICING OF CONTRACT MODIFICATIONS (DEC 1991) DFARS 252.243-7001

When costs are a factor in any price adjustment under this contract, the contract cost principles and procedures in FAR Part 31 and DFARS Part 231, in effect on the date of this contract, apply.

(End of clause)

99. CERTIFICATION OF REQUESTS FOR EQUITABLE ADJUSTMENT (JUL 1997) DFARS 252.243-7002

(a) In accordance with 10 U.S.C. 2410(a), any request for equitable adjustment to contract terms that exceeds the simplified acquisition threshold shall bear, at the time of submission, the following certificate executed by an individual authorized to certify the request on behalf of the Contractor:

I certify that the request is made in good faith, and that the supporting data are accurate and complete to the best of my knowledge and belief.

_____
(Official's Name)

_____
(Title)

(b) The certification in paragraph (a) of this clause requires full disclosure of all relevant facts, including--

(1) Cost or pricing data if required in accordance with FAR 15.804-2; and

(2) Actual cost data and data to support any estimated costs, even if cost or pricing data are not required.

(c) The certification requirement in paragraph (a) of this clause does not apply to --

(1) Requests for routine contract payments; for example, requests for payment for accepted supplies and services, routine vouchers under a cost-reimbursement type contract, or progress payment invoices; or

(2) Final adjustments under an incentive provision of the contract.

(d) The amount requested shall accurately reflect the contract adjustment for which the Contractor believes the Government is liable. The request shall include only costs for performing the change, and shall not include any costs that already have been reimbursed or that have been separately claimed. All indirect costs included in the request shall be properly allocable to the change in accordance with applicable acquisition regulations.

(End of clause)

100. GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989) FAR 52.245-2

NOTE: This clause applies only when the acquisition cost of all Government-furnished property to be involved in the contract is more than $100,000.

(a) *Government-furnished property*. (1) The Government shall deliver to the Contractor, for use in connection with and under the terms of this contract, the Government-furnished property described in the Schedule or specifications together with any related data and information that the Contractor may request and is reasonably required for the intended use of the property (hereinafter referred to as "Government-furnished property").

(2) The delivery or performance dates for this contract are based upon the expectation that Government-furnished property suitable for use (except for property furnished "as is") will be delivered to the Contractor at the times stated in the Schedule or, if not so stated, in sufficient time to enable the Contractor to meet the contract's delivery or performance dates.

(3) If Government-furnished property is received by the Contractor in a condition not suitable for the intended use, the Contractor shall, upon receipt of it, notify the Contracting Officer, detailing the facts, and, as directed by the

Contracting Officer and at Government expense, either repair, modify, return, or otherwise dispose of the property. After completing the directed action and upon written request of the Contractor, the Contracting Officer shall make an equitable adjustment as provided in paragraph (h) of this clause.

(4) If Government-furnished property is not delivered to the Contractor by the required time, the Contracting Officer shall, upon the Contractor's timely written request, make a determination of the delay, if any, caused the Contractor and shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(b) *Changes in Government-furnished property*. (1) The Contracting Officer may, by written notice, (i) decrease the Government-furnished property provided or to be provided under this contract, or (ii) substitute other Government-furnished property for the property to be provided by the Government, or to be acquired by the Contractor for the Government, under this contract. The Contractor shall promptly take such action as the Contracting Officer may direct regarding the removal, shipment, or disposal of the property covered by such notice.

(2) Upon the Contractor's written request, the Contracting Officer shall make an equitable adjustment to the contract in accordance with paragraph (h) of this clause, if the Government has agreed in the Schedule to make the property available for performing this contract and there is any--

(i) Decrease or substitution in this property pursuant to subparagraph (b)(1) above; or

(ii) Withdrawal of authority to use this property, if provided under any other contract or lease.

(c) *Title in Government property*. (1) The Government shall retain title to all Government-furnished property.

(2) All Government-furnished property and all property acquired by the Contractor, title to which vests in the Government under this paragraph (collectively referred to as "Government property"), are subject to the provisions of this clause. However, special tooling accountable to this contract is subject to the provisions of the Special Tooling clause and is not subject to the provisions of this clause. Title to Government property shall not be affected by its incorporation into or attachment to any property not owned by the Government, nor shall Government property become a fixture or lose its identity as personal property by being attached to any real property.

(3) Title to each item of facilities and special test equipment acquired by the Contractor for the Government under this contract shall pass to and vest in the Government when its use in performing this contract commences or when the Government has paid for it, whichever is earlier, whether or not title previously vested in the Government.

(4) If this contract contains a provision directing the Contractor to purchase material for which the Government will reimburse the Contractor as a direct item of cost under this contract--

(i) Title to material purchased from a vendor shall pass to and vest in the Government upon the vendor's delivery of such material; and

(ii) Title to all other material shall pass to and vest in the Government upon--

(A) Issuance of the material for use in contract performance;

(B) Commencement of processing of the material or its use in contract performance; or

(C) Reimbursement of the cost of the material by the Government, whichever occurs first.

(d) *Use of Government property*. The Government property shall be used only for performing this contract, unless otherwise provided in the contract or approved by the Contracting Officer.

(e) *Property administration*. (1) The Contractor shall be responsible and accountable for all Government property provided under this contract and shall comply with Federal Acquisition Regulation (FAR) Subpart 45.5, as in effect on the date of this contract.

(2) The Contractor shall establish and maintain a program for the use, maintenance, repair, protection, and preservation of Government property in accordance with sound industrial practice and the applicable provisions of Subpart 45.5 of the FAR.

(3) If damage occurs to Government property, the risk of which has been assumed by the Government under this contract, the Government shall replace the items or the Contractor shall make such repairs as the Government directs. However, if the Contractor cannot effect such repairs with the time required, the Contractor shall dispose of the property as directed by the Contracting Officer. When any property for which the Government is responsible is replaced or repaired, the Contracting Officer shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(4) The Contractor represents that the contract price does not include any amount for repairs or replacement for which the Government is responsible. Repairs or replacement of property for which the Contractor is responsible shall be accomplished by the Contractor at its own expense.

(f) *Access*. The Government and all its designees shall have access at all reasonable times to the premises in which any Government property is located for the purpose of inspecting the Government property.

(g) *Risk of loss*. Unless otherwise provided in this contract, the Contractor assumes the risk of, and shall be responsible for, any loss or destruction of, or damage to, Government property upon its delivery to the Contractor or upon passage of title to the Government under paragraph (c) of this clause. However, the Contractor is not responsible for

reasonable wear and tear to Government property or for Government property properly consumed in performing this contract.

(h) *Equitable adjustment*. When this clause specifies an equitable adjustment, it shall be made to any affected contract provision in accordance with the procedures of the Changes clause. When appropriate, the Contracting Officer may initiate an equitable adjustment in favor of the Government. The right to an equitable adjustment shall be the Contractor's exclusive remedy. The Government shall not be liable to suite for breach of contract for--

(1) Any delay in delivery of Government-furnished property;

(2) Delivery of Government-furnished property in a condition not suitable for its intended use;

(3) A decrease in or substitution of Government-furnished property; or

(4) Failure to repair or replace Government property for which the Government is responsible.

(i) *Final accounting and disposition of Government property* Upon completing this contract, or at such earlier dates as may be fixed by the Contracting Officer, the Contractor shall submit, in a form acceptable to the Contracting Officer, inventory schedules covering all items of Government property (including any resulting scrap) not consumed in performing this contract or delivered to the Government. The Contractor shall prepare for shipment, delivery f.o.b. origin, or dispose of the Government property as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as the Contracting Officer directs.

(j) *Abandonment and restoration of Contractor's premises*. Unless otherwise provided herein, the Government--

(1) May abandon any Government property in place, at which time all obligations of the Government regarding such abandoned property shall cease; and

(2) Has no obligation to restore or rehabilitate the Contractor's premises under any circumstances (e.g., abandonment, disposition upon completion of need, or upon contract completion). However, if the Government-furnished property (listed in the Schedule or specifications) is withdrawn or is unsuitable for the intended use, or if other Government property is substituted, then the equitable adjustment under paragraph (h) of this clause may properly include restoration or rehabilitation costs.

(k) *Communications*. All communications under this clause shall be in writing.

(l) *Overseas contracts*. If this contract is to be performed outside of the United States of America, its territories, or possessions, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.

(End of clause)

101. GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (APR 1984) FAR 52.245-4

NOTE: This clause applies only when the acquisition cost of all Government-furnished property to be involved in the contract is $100,000 or less.

(a) The Government shall delivery to the Contractor, at the time and locations stated in this contract, the Government-furnished property described in the Schedule or specifications. If that property, suitable for its intended used, is not delivered to the Contractor, the Contracting Officer shall equitably adjust affected provisions of this contract in accordance with the Changes clause when--

(1) The Contractor submits a timely written request for an equitable adjustment; and

(2) The facts warrant an equitable adjustment.

(b) Title to Government-furnished property shall remain in the Government. The Contractor shall use the Government-furnished property only in connection with this contract. The Contractor shall maintain adequate property control records in accordance with sound industrial practice and will make such records available for Government inspection at all reasonable times, unless the clause at Federal Acquisition Regulation 52.245-1, Property Records, is included in this contract.

(c) Upon delivery of Government-furnished property to the Contractor, the Contractor assumes, the risk and responsibility for its loss or damage, except--

(1) For reasonable wear and tear;

(2) To the extent property is consumed in performing this contract; or

(3) As otherwise provided for by the provisions of this contract.

(d) Upon completing this contract, the Contractor shall follow the instructions of the Contracting Officer regarding the disposition of all Government-furnished property not consumed in performing this contract or previously delivered to the Government. The Contractor shall prepare for shipment, delivery f.o.b. origin, or dispose of the Government property, as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as directed by the Contracting Officer.

(e) If this contract is to be performed outside the United States of America, its territories, or possessions, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.

(End of clause)

102. REPORTS OF GOVERNMENT PROPERTY (MAY 1994) DFARS 252.245-7001

(a) The Contractor shall provide an annual report--

(1) For all DoD property for which the Contractor is accountable under the contract;

(2) Prepared in accordance with the requirements of DD Form 1662, DoD Property in the Custody of Contractors, or approved substitute, including instructions on the reverse side of the form;

(3) In duplicate, to the cognizant Government property administrator, no later than October 31.

(b) The Contractor is responsible for reporting all Government property accountable to this contract, including that at subcontractor and alternate locations.

(End of clause)

103. INSPECTION OF CONSTRUCTION (AUG 1996) FAR 52.246-12

(a) *Definition*. "Work" includes, but is not limited to, materials, workmanship, and manufacture and fabrication of components.

(b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

(c) Government inspections and tests are for the sole benefit of the Government and do not--

(1) Relieve the Contractor of responsibility for providing adequate quality control measures;

(2) Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;

(3) Constitute or imply acceptance; or

(4) Affect the continuing rights of the Government after acceptance of the complete work under paragraph (i) below.

(d) The presence or absence of a Government inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specification without the Contracting Officer's written authorization.

(e) The Contractor shall promptly furnish, at no increase in contract price, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The Government may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The Government shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

(f) The Contractor shall, without charge, replace or correct work found by the Government not to conform to contract requirements, unless in the public interest the Government consents to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(g) If the Contractor does not promptly replace or correct rejected work, the Government may (1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor or (2) terminate for default the Contractor's right to proceed.

(h) If, before acceptance of the entire work, the Government decides to examine already completed work by removing it or tearing it out, the Contractor, on request, shall promptly furnish all necessary facilities, labor, and material. If the work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray the expenses of the examination and of satisfactory reconstruction. However, if the work is found to meet contract requirements, the Contracting Officer shall make an equitable adjustment for the additional services involved in the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

(i) Unless otherwise specified in the contract, the Government shall accept, as promptly as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines

can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee.

(End of clause)

104. VALUE ENGINEERING--CONSTRUCTION (MAR 1989)--ALTERNATE I (APR 1984) FAR 52.248-3 I

(a) *General*. The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) below.

(b) *Definitions*. "Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractors' development and implementation costs (see paragraph (h) below).

"Value engineering change proposal (VECP): means a proposal that--

(1) Requires a change to this, the instant contract, to implement; and

(2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; *provided*, that it does not involve a change--

(i) In deliverable end item quantities only; or

(ii) To the contract type only.

(c) VECP preparation. As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for (i) the affected portions of the existing contract requirement and (ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A predicting of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) *Submission*. The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) *Government action*. (1) The Contracting Officer shall notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer shall notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decisions. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Contracting Officer shall notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the

Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

(3) Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Contracting Officer's decision to accept or reject all or part of any VECP shall be final and not subject to the Disputes clause or otherwise subject to litigation under the Contract Disputes Act of 1978 (41 U.S.C. 601-613).

(f) *Sharing*. (1) *Rates*. The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by (i) 45 percent for fixed-price contracts or (ii) 75 percent for cost-reimbursement contracts.

(2) *Payment*. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

(i) Accept the VECP;

(ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) *Subcontracts*. The Contractor shall include an appropriate value engineering clause in any subcontract of $50,000 or more an may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; *provided*, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(h) *Data*. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

> "These data, furnished under the Value Engineering--Construction clause of contract _____, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."

If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

(End of clause)

105. TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SEP 1996)--ALTERNATE I (SEP 1996) FAR 52.249-2 I

(a) The Government may terminate performance of the work under this contract in whole or in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

(1) Stop work as specified in the notice.

(2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.

(3) Terminate all subcontracts to the extent they relate to the work terminated.

(4) Assign to the Government, as directed by the Contracting Officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.

(5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and delivery to the Government (i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.

(7) Complete performance of the work not terminated.

(8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.

(9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (b)(6) of this clause; *provided*, however, that the Contractor (i) is not required to extend credit to any purchaser and (ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.

(c) The Contractor shall submit complete termination inventory schedules no later than 120 days from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 120-day period.

(d) After expiration of the plant clearance period as defined in Subpart 45.6 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.

(e) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1-year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of information available, the amount, if any due the Contractor because of the termination and shall pay the amount determined.

(f) Subject to paragraph (e) of this clause, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (f) or paragraph (g) of this clause, exclusive of costs shown in subparagraph (g)(3) of this clause, may not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be modified, and the Contractor paid the agreed amount. Paragraph (g) of this clause shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(g) If the Contractor and the Contracting Officer fail to agree on the whole amount to be paid because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (f) of this clause:

(1) For contract work performed before the effective date of termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (g)(1)(i) of this clause; and

(iii) A sum, as profit on subdivision (g)(1)(i) of this clause, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(h) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (g) of this clause, the fair value, as determined by the Contracting Officer, of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer.

(i) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all costs claimed, agreed to, or determined under this clause.

(j) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (e), (g), or (l) of this clause, except that if the Contractor failed to submit the termination settlement proposal or request for equitable adjustment within the time provided in paragraph (e) or (l), respectively, and failed to request a time extension, there is not right of appeal.

(k) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(l) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(m)(1) The Government may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess is repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(n) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under this contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

(End of clause)

106. DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984) FAR 52.249-10

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if--

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include (i) acts of God or of the public enemy, (ii) acts of the Government in either its sovereign or contractual capacity, (iii) acts of another Contractor in the performance of a contract with the Government, (iv) fires, (v) floods, (vi) epidemics, (vii) quarantine restrictions, (viii) strikes, (ix) freight embargoes, (x) unusually severe weather, or (xi) delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Government.

(d) The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

107. COMPUTER GENERATED FORMS (JAN 1991) FAR 52.253-1

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, *provided* the form carries the Standard or Optional Form number and edition data.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition data.

(c) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

END OF SECTION 00700

Section 00800 Index

01. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK 1
02. LIQUIDATED DAMAGES--CONSTRUCTION 1
03. thru 5. NOT USED 1
06. CONTRACT DRAWINGS, MAPS AND SPECIFICATIONS 1
07. NOT USED 2
08. RIGHTS IN SHOP DRAWINGS 2
09. NOT USED 2

10. EQUIPMENT DATA 2
11. thru 13. NOT USED 3
14. LAYOUT OF WORK 3
15. PERFORMANCE OF WORK BY THE CONTRACTOR 3
16. thru 32. NOT USED 3

33. WAGE RATES 3
34. thru 37. NOT USED 4
38. COMPLIANCE WITH POST/BASE REGULATIONS 4
39. thru 41. NOT USED. 4

42. PROGRESS PHOTOGRAPHS 4
43. and 44. NOT USED 4
45. INSURANCE--WORK ON A GOVERNMENT INSTALLATION 4
46. and 47. NOT USED 5
48. DEFINITIONS 5
49. tnru 53. NOT USED 5

54. FIRE PROTECTION DURING CONSTRUCTION 5
55. thru 57. NOT USED 5
58. CONSTRUCTION HAZARD COMMUNICATION 5
59. and 60. NOT USED. 7

61. MECHANICAL ROOM LAYOUT 7
62. thru 68. NOT USED 7
69. BASIS FOR SETTLEMENT OF PROPOSALS 7

70. NOT USED. 7
71. PARTNERING 7
72. thru 82. NOT USED 8

83. YEAR 2000 COMPLIANCE 8

SECTION 00800

SPECIAL CONTRACT REQUIREMENTS

2 January 1996
1. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK (APR 1984) FAR 52.211-10. The Contractor shall be required to commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, prosecute said work diligently, and complete the entire work ready for use not later than 654 calendar days after date of receipt of notice to proceed. The time stated for completion shall include as-built drawings, O&M manuals, operational tests/reports/training/instructions, equipment lists, and final cleanup of the premises.

2 January 1996
2. LIQUIDATED DAMAGES--CONSTRUCTION (APR 1984) FAR 52.211-12.

2.1 If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of $396.45 for each day of delay.

2.2 If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

2.3 If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

3. thru 5. NOT USED.

1 August 1996
(2) 6. CONTRACT DRAWINGS, MAPS AND SPECIFICATIONS (DEC 1991) DFARS 252.236-7001.

6.1 The Government--

(1) Will furnish the Contractor one set of reproducibles, of half-size drawings.

(2) Drawings and specifications are available in the office of the Corps of Engineers, Department of the Army, Room 821, Dr. Martin Luther King, Jr. Place, Louisville, Kentucky.

6.2 The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies; and

(4) Be responsible for any errors which might have been avoided by complying with paragraph 6.2 (1), (2) and (3).

6.3 Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications.

6.4 The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

19 October 1987

TABLE OF DRAWINGS

Drawing No.	Title	Latest Rev. No. & Date
X1.1	COVER SHEET	
X1.2	LOCATION MAPS	
X1.3	LEGEND SHEET	
X1.4	ABBREVIATIONS	
C1	OVERALL SITE PLAN	
C2	DEMOLITION PLAN	
C3	LAYOUT PLAN	
C4	GRADE & DRAIN PLAN	
C5	EROSION CONTROL PLAN	
C6	UTILITY PLAN	
C7	UTILITY PLAN	
C8	COMPASS ROSE PLAN	
C9	AIRCRAFT PARKING LAYOUT	
C10	STORM PROFILES	
C11	SANITARY PROFILES	
C12	EROSION CONTROL NOTES	
C13	EROSION CONTROL DETAILS	
C14	EROSION CONTROL DETAILS	
C15	PAVING DETAILS	
C16	DETAILS	
C17	DETAILS	
C18	DETAILS	
C19	DETAILS	
C20	DETAILS	
C21	DETAILS	
C22	DETAILS	
C23	COMPASS CALIBRATION PAD	
FP0	LIFE SAFETY - CODE REVIEW	
FP1.0	LIFE SAFETY PLAN	
A1.1	COMPOSITE PLAN	
A1.1.1	FLOOR PLAN	
A1.1.2	FLOOR PLAN	
A1.1.3	FLOOR PLAN	
A1.1.4	FLOOR PLAN	
A2.1.1	REFLECTED CEILING PLAN	
A2.1.2	REFLECTED CEILING PLAN	
A2.1.3	REFLECTED CEILING PLAN	
A2.1.4	REFLECTED CEILING PLAN	
A3.1	ROOF PLAN	
A3.2	ROOF DETAILS	
A4.1.1	BUILDING ELEVATIONS	
A4.1.2	BUILDING ELEVATIONS	

A4.1.3	BUILDING ELEVATIONS
A5.1.1	BUILDING SECTION
A5.1.2	BUILDING SECTION
A5.2	WALL SECTIONS
A5.3	WALL SECTIONS
A5.4	WALL SECTIONS/DETAILS
A6.1	DOOR SCHEDULE
A6.2	DOOR DETAILS
A6.3	DOOR DETAILS
A6.4	HANGER DOOR DETAILS
A7.1	WINDOW TYPES AND LOUVER TYPES
A7.2	LOUVER TYPES
A7.3	WALL DETAILS
A7.4	WINDOW DETAILS
A8.1.1	ENLARGED RESTROOM PLAN & DETAILS
A8.1.2	RESTROOM ELEVATIONS
A8.1.3	RESTROOM ELEVATIONS
A8.1.4	RESTROOM ELEVATIONS
A9.1	DETAILS
A9.2	DETAILS
A9.3	DETAILS
A9.4	DETAILS
A9.5	DETAILS
A9.6	DETAILS
A11.1	ENLARGED VAULT PLAN & DETAILS
A12.1	FINISH AND COLOR SCHEDULES
A12.2	SPECIAL ITEM COLOR SCHEDULE
A13.0	SIGNAGE SCHEDULE AND DETAILS
A13.1.1	SIGNAGE PLAN
F1.1.1	FURNITURE PLAN
F1.1.2	FURNITURE PLAN
F1.2.1	SYSTEMS COMPONENT PLAN
F1.2.2	SYSTEMS COMPONENT PLAN
F1.3.1	SYSTEMS PANEL PLAN
F1.3.2	SYSTEMS PANEL PLAN
S1.1	GENERAL NOTES
S2.1.1	FOUNDATION AND FLOOR SLAB PLAN
S2.1.2	FOUNDATION AND FLOOR SLAB PLAN
S2.1.3	FOUNDATION AND FLOOR SLAB PLAN
S2.1.4	FOUNDATION AND FLOOR SLAB PLAN
S2.2.1	LOW ROOF FRAMING PLAN
S2.2.2	LOW ROOF FRAMING PLAN
S2.2.3	LOW ROOF FRAMING PLAN
S2.2.4	LOW ROOF FRAMING PLAN
S2.3.1	BOTTOM CHORD FRAMING PLAN
S2.3.2	BOTTOM CHORD FRAMING PLAN
S2.3.3	BOTTOM CHORD FRAMING PLAN
S2.3.4	BOTTOM CHORD FRAMING PLAN
S2.4.1	HANGAR BAY ROOF FRAMING PLAN
S2.4.2	HANGAR BAY ROOF FRAMING PLAN
S2.4.3	HANGAR BAY ROOF FRAMING PLAN
S2.4.4	HANGAR BAY ROOF FRAMING PLAN
S3.1	COLUMN AND FOUNDATION SCHEDULE
S3.2	COLUMN AND FOUNDATION SCHEDULE
S3.3	FOUNDATION DETAILS
S3.4	FOUNDATION SECTIONS
S3.5	FOUNDATION SECTIONS
S3.6	FOUNDATION SECTIONS
S3.7	FOUNDATION SECTIONS AND DETAILS
S3.8	COLUMN BASE PLATE DETAILS

S4.1	SECTIONS AND DETAILS
S4.2	SECTIONS AND DETAILS
S4.3	SECTIONS AND DETAILS
S4.4	SECTIONS AND DETAILS
S4.5	SECTIONS AND DETAILS
S4.6	SECTIONS AND DETAILS
S4.7	SECTIONS AND DETAILS
S4.8	SECTIONS AND DETAILS
S4.9	VAULT SLAB PLAN AND SECTIONS
S5.1	TYPICAL TRUSS ELEVATION
S5.2	TRUSS DETAILS
S5.3	TRUSS DETAILS
S5.4	BOX TRUSS ELEVATIONS AND SECTIONS
S5.5	TRUSS DETAILS
S5.6	TRUSS SECTIONS AND DETAILS
S5.7	TRUSS SECTIONS AND DETAILS
S5.8	TRUSS SECTIONS AND DETAILS
S6.1	FRAMING ELEVATIONS
S6.2	FRAMING ELEVATIONS
S6.3	FRAMING DETAILS
S7.1	STAIR PLAN AND SECTIONS
S7.2	STAIR SECTIONS AND DETAILS
S7.3	STAIR SECTIONS AND DETAILS
S8.1	TYPICAL MASONRY DETAILS
ML1.1	MECHANICAL LEGEND
M1.1.1	(1) FIRST FLOOR HVAC PLAN
M1.1.2	(2) FIRST FLOOR HVAC PLAN
M1.1.3	(3) FIRST FLOOR HVAC PLAN
M1.1.4	(4) FIRST FLOOR HVAC PLAN
M2.1.1	ENLARGED MECHANICAL ROOM PLAN
M3.1.1	SECTIONS
M4.1.1	DETAILS
M4.1.2	DETAILS
M4.1.3	DETAILS
M4.1.4	DETAILS
M5.1.1	SCHEDULES
M5.1.2	SCHEDULES
M6.1.1	CONTROLS
M6.1.2	CONTROLS
M6.1.3	CONTROLS
M6.1.4	CONTROLS
M6.1.5	CONTROLS
M6.1.6	CONTROLS
P1.1.1	PLUMBING PLAN
P1.1.2	PLUMBING PLAN
P1.1.3	PLUMBING PLAN
P1.1.4	PLUMBING PLAN
P2.1.1	ENLARGED RESTROOM PLAN & RISERS
P3.1.1	DETAILS
P4.1.1	SCHEDULES
FP1.1.1 1	FIRST FLOOR - FIRE PROTECTION PLAN
FP1.1.2 2	FIRST FLOOR - FIRE PROTECTION PLAN
FP1.1.3 3	FIRST FLOOR - FIRE PROTECTION PLAN
FP1.1.4 4	FIRST FLOOR - FIRE PROTECTION PLAN
FP2.1.1	ENLARGED PLAN & SECTIONS
FP2.1.2	DETAILS
E0.1	ELECTRICAL LEGEND
E0.2	HAZARDOUS CLASSIFICATION PLAN
EU1.1	ELECTRICAL SITE PLAN
EU2.1	ELECTRICAL SITE DETAILS

EU2.2	ELECTRICAL SITE DETAILS
EU2.3	ELECTRICAL SITE DETAILS
EU2.4	ELECTRICAL SITE DETAILS
EU2.5	ELECTRICAL SITE DETAILS
EU2.5	ELECTRICAL SITE DETAILS
E1.1.1	LIGHTING PLAN
E1.1.2	LIGHTING PLAN
E1.1.3	LIGHTING PLAN
E1.1.4	LIGHTING PLAN
E1.1.5	LIGHTING PLAN - HANGAR
E2.1.1	POWER PLAN
E2.1.2	POWER PLAN
E2.1.3	POWER PLAN
E2.1.4	POWER PLAN
E2.1.5	POWER PLAN - HANGAR
E2.1.6	ENLARGED POWER PLAN
E2.1.7	POWER PLAN - HANGAR
E3.1.1	SIGNAL PLAN
E3.1.2	SIGNAL PLAN
E3.1.3	SIGNAL PLAN
E3.1.4	SIGNAL PLAN
E3.1.5	ENLARGED SIGNAL PLAN
E4.1.1	LIGHTNING PROTECTION PLAN
E5.0	LIGHTING FIXTURE SCHEDULE
E5.1	LIGHTING DETAILS
E5.2	LIGHTING DETAILS
E5.3	LIGHTING DETAILS
E5.4	LIGHTING DETAILS
E5.5	LIGHTING DETAILS
E6.1	POWER DETAILS
E6.2	POWER DETAILS
E6.3	POWER DETAILS
E6.4	POWER DETAILS
E7.1	SECURITY DETAILS
E8.1	POWER ONE-LINE
E8.2	COMMUNICATIONS RISER DIAGRAM
E8.3	FIRE ALARM/SECURITY RISER DIAGRAM
E8.4	POWER ONE-LINE CONTINUED
E9.1	PANEL SCHEDULES
E9.2	PANEL SCHEDULES
E9.3	PANEL SCHEDULES
AS1.1	UNHEATED STORAGE BUILDING
AS1.2	UNHEATED STORAGE BUILDING DETAILS
SS1.1	FOUNDATION AND FLOOR SLAB PLAN
SS2.1	SCHEMATIC FRAMING PLAN AND SECTION
MS1.1	UNHEATED STORAGE BUILDING
ES1.1	LIGHTING PLAN - STORAGE
ES2.1	POWER PLAN - STORAGE
ES4.1	LIGHTNING PROTECTION PLAN - STORAGE

7. NOT USED.

17 JULY 1992

8. RIGHTS IN SHOP DRAWINGS (APR 1966) DFARS 252.227-7033.

8.1 Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower tier subcontractor pursuant to a construction contract, showing detail (I) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or

equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

8.2 This clause, including this paragraph (8.2), shall be included in all subcontracts hereunder at any tier.

9. NOT USED.

15 June 1990
(1) 10. EQUIPMENT DATA.

10.1 Real Property Equipment. The Contractor shall be required to make a list of all installed equipment furnished under this contract. This list shall include all information usually listed on manufacturer's name plate. The form is part of SPECIAL CONTRACT REQUIREMENTS and is included following the SPECIAL CONTRACT REQUIREMENTS, so to positively identify the piece of property. The list shall also include the cost of each piece of installed property F.O.B. construction site. For each of the items which is specified herein to be guaranteed for a specified period from the date of acceptance thereof, the following information shall be given: The name, serial and model number address of equipment supplier, or manufacturer originating the guaranteed item. The Contractor's guarantee to the Government of these items will not be limited by the terms of any manufacturer's guarantee to the Contractor. The list shall be furnished as one (1) reproducible and three (3) copies and shall be furnished to the Contracting Officer not later than thirty (30) calendar days prior to completion of any segment of the contract work which has an incremental completion date.

10.2 Maintenance and Parts Data. The Contractor will be required to furnish a brochure, catalog cut, parts list, manufacturer's data sheet or other publication which will show detailed parts data on all other equipment subject to repair and maintenance procedures not otherwise required in Operations and Maintenance Manuals specified elsewhere in this contract. Distribution of directives shall follow the same requirements as listed in paragraph 10.1.

11. thru 13. NOT USED.

15 June 1990
(1) 14. LAYOUT OF WORK (APR 1984) FAR 52.236-17. The Contractor shall lay out its work from Government-established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at his own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

15 June 1990
15. PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984) FAR 52.236-1 (Para. 15 only). The Contractor shall perform on the site, and with its own organization, work equivalent to at least 20 percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the

Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

15.1 For purposes of this paragraph "WORK BY THE CONTRACTOR" is defined as prime Contractor direct contract labor (including testing and layout personnel), exclusive of other general condition or field overhead personnel, material, equipment, or subcontractors. The "TOTAL AMOUNT OF WORK" is defined as total direct contract labor (including testing and layout personnel), exclusive of other general condition or field overhead personnel, material, or equipment.

15.2 Within 7 days after the award of any subcontract, either by himself or a subcontractor, the Contractor shall deliver to the Contracting Officer a completed SF 1413, "Statement and Acknowledgment." The form shall include the subcontractor's acknowledgement of the inclusion in his subcontract of the clauses of this contract entitled "Davis-Bacon Act," "Contract Work Hours and Safety Standards Act-Overtime Compensation," "Apprentices and Trainees," "Compliance with Copeland Regulations," "Withholding of Funds," "Subcontracts," "Contract Termination-Debarment," and "Payrolls and Basic Records." Nothing contained in this contract shall create any contractual relation between the subcontractor and the Government.

16. thru 32. NOT USED.

1 February 1995

33. WAGE RATES. The decision of the Secretary of Labor, covering rates of wages, including fringe benefits to be paid laborers and mechanics performing work under this contract, is attached hereto. The payment for all classes of laborers and mechanics actually employed to perform work under the contract will be specified in the following contract clauses: DAVIS-BACON ACT, CONTRACT WORK HOURS AND SAFETY STANDARDS ACT, and THE COPELAND ACT.

34. thru 37. NOT USED.

1 August 1996

38. COMPLIANCE WITH POST/BASE REGULATIONS. The site of the work is on a military reservation and all rules and regulations issued by the Commanding Officer covering general safety, security, sanitary requirements, pollution control and traffic regulations, shall be observed by the Contractor. Information regarding these requirements may be obtained by contacting the Contracting Officer, who will provide such information or assist in obtaining same from appropriate authorities.

38.1 Contractor personnel shall park only in areas authorized by the Contracting Officer.

39. thru 41. NOT USED.

24 January 1994

(3) 42. PROGRESS PHOTOGRAPHS. The Contractor shall, during the progress of the work, furnish the Contracting Officer photographs, slides and negatives to depict progress of construction. The photographic work shall be commercial quality as determined by the Contracting Officer. The photography shall be performed between the first and fifth of each month and the photographs, slides and negatives delivered to the Contracting Officer not later than the 15th of each month taken. A maximum of six views from different positions shall be taken as directed to show, inasmuch as possible, work accomplished during the previous month. At least, one set of photographs, slides and negatives shall be made at completion of the contract after the final inspection by the Contracting Officer. The photographs shall be 8"x10" color prints and the slides 35 mm color. Each photograph and slide shall be identified on the face of the picture

or the border of the slide giving the date made, contract title and number, location of work, as well as a brief description of work depicted. Each negative will be identified with the same information on a sheet of paper by cross-referencing to the number on the negative. Two copies of photographs and slides, along with the original negatives of each view taken, shall be furnished to the Contracting Officer by the time stipulated above. No separate payment will be made for these services and all costs in connection thereto shall be considered a subsidiary obligation of the Contractor.

43. and 44. NOT USED.

17 July 1992

45. INSURANCE--WORK ON A GOVERNMENT INSTALLATION (SEP 1989) FAR 52.228-5.

45.1 The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(1) Coverage complying with State laws governing insurance requirements, such as those requirements pertaining to Workman's Compensation and Occupational Disease Insurance. Employer's Liability Insurance shall be furnished in limits of not less than $100,000.00 except in states with exclusive or monopolistic funds.

(2) Comprehensive General Liability Insurance for bodily injury coverage shall be furnished in limits of not less than $500,000 per occurrence.

(3) Comprehensive Automobile Liability Insurance for both bodily injury and property damage, shall be furnished in limits of not less than $200,000.00 per person, $500,000.00 per accident for bodily injury, and $20,000.00 per accident for property damage. When the Financial Responsibility or Compulsory Insurance Law of the State, requires higher limits, the policy shall provide for coverage of at least those higher limits.

45.2 Before commencing work under this contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe, or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

45.3 The Contractor shall insert the substance of this clause, including this paragraph (45.3), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

46. and 47. NOT USED.

15 June 1990

48. DEFINITIONS. The following provision is applicable to the SPECIFICATIONS, of this solicitation: The term GENERAL PROVISIONS shall mean CONTRACT CLAUSES, the terms SPECIAL PROVISIONS and SPECIAL CLAUSES shall mean SPECIAL CONTRACT REQUIREMENTS.

49. thru 53. NOT USED.

15 April 1991

54. FIRE PROTECTION DURING CONSTRUCTION (MIL-HDBK-1008b Para. 2.9.2) The Contractor is alerted to the requirements of Contract Clause "CLEANING UP" and more specifically to the requirements for fire protection during construction spelled out in EM 385-1-1 and NFPA No. 241 Building Construction and Demolition Operations. This item must be covered in the submittal required under Contract Clause "ACCIDENT PREVENTION".

55. thru 57. NOT USED.

1 November 1991

58. CONSTRUCTION HAZARD COMMUNICATION. The Contractor is required to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1926.59). This standard is designed to inform workers of safe and appropriate methods of working with hazardous substances in the workplace. The standard has five requirements, and every hazardous or potentially hazardous substance used or stored in the work area is subject to all five. They are:

(1) Hazard Evaluation. Any company which produces or imports a chemical or compound must conduct a hazard evaluation of the substance to determine its potential health or physical hazard. The hazard evaluation consists of an investigation of all the available scientific evidence about the substance. The Contractor is required to assure that all producers (manufacturer/distributors) have performed these evaluations and transmit the required information with any hazardous materials being used or stored on the project site. From the hazard evaluation, a substance may be classified as a health hazard, or a physical hazard. These classifications are then further broken down according to type:

Health Hazards	Physical Hazards
Carcinogens	Combustible liquids
Irritants	Compressed gases
Sensitizers	Explosives
Corrosives	Flammables
Toxic substances	Organic peroxides
Highly toxic substances	Unstable substances
Substances harmful to specific organs or parts of the body	Water-reactive substances

(2) Warning Labels. If a chemical is hazardous or potentially hazardous, the producer or importer must affix a warning label to every container of that chemical before it leaves his facility. The Contractor must assure these labels are attached and legible. The label must identify the chemical, state the hazard, and give the name and address of the producer or importer. If the hazardous substance is transferred to another container, that container must then be labeled, tagged, or marked with the name of the chemical and the appropriate hazard warning. Warning labels should be replaced immediately if they are defaced or removed.

(3) Material Safety Data Sheets. The producer or importer must also supply a material safety data sheet (MSDS). The Contractor must keep these available in the work area where the substance is used, so that the people using the substance can easily review important safety and health information, such as:

The hazard possible from misuse of the substance

Precautions necessary for use, handling, and storage
Emergency procedures for leaks, spills, fire and first aid
Useful facts about the substance's physical or chemical properties

(4) Work Area Specific Training. Because of hazardous substance may react differently depending on how it is used or the environment of the work area, the Contractor must conduct work area specific training; special training which takes the Contractor's operations, environment, and work policies into consideration. Work area training presents:

The hazardous substances which are present in the work place and the hazards they pose

Ways to protect against those hazards, such as protective equipment, emergency procedures, and safe handling

Where the MSDS's are kept, and an explanation of the labeling system
Where the Contractor's written Hazard Communication Program is located

(5) The Written Hazard Communication Program. In accordance with OSHA requirements, the Contractor must prepare a written Hazard Communication Program. This document will be included in the Contractor's Accident Prevention Plan. This document states how the Contractor plans to ensure that hazardous materials are appropriately labeled, how and where MSDS's will be maintained, and how employees will be provided with specific information and training.

59. and 60. NOT USED.

24 FEBRUARY 1992

61. MECHANICAL ROOM LAYOUT (ORL). Detailed mechanical room layout drawings shall be submitted for approval in accordance with SD-04 Section 01330. Layout drawings shall show location and maintenance clearances for all mechanical room equipment, and all utility runs/chases for mechanical, electrical, telephone and other similar systems. Drawings shall be submitted at the same time as the submittals for the equipment to be located within the mechanical room.

62. thru 68. NOT USED.

2 January 1996

69. BASIS FOR SETTLEMENT OF PROPOSALS. EFARS 52.249-5000. Actual costs will be used to determine equipment costs for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a terminations settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(1) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the contractor's accounting records to determine total actual equipment costs.

(2) If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

(3) Recorded job costs adjusted for allowable expenses will be used to determine equipment operating expenses.

(4) Ownership costs (depreciation) will be determined using the contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

70. NOT USED.

8 October 1996

71. PARTNERING. In order to most effectively and efficiently accomplish the work provided for in this contract, the Government is encouraging the formation of a cohesive, mutually beneficial partnership with the Contractor and its subcontractors. This partnership would strive to draw on the strengths, skills, and knowledge of each organization in an effort to achieve a quality project, done right the first time, within budget, safely, and on schedule. Partnering still requires full compliance with the contract, but the focus of partnering is to build cooperative relationships, avoid or minimize disputes and actively pursue the attainment of common goals by the contracting parties. Success will be dependent upon teamwork characterized by open and effective communication while always adhering to the highest of professional standards. The partnership would be bilateral in makeup and participation will be totally voluntary. Any cost associated with effectuating this partnership will be agreed to by both parties and will be shared equally with no change in contract price.

72. thru 82. NOT USED.

22 June 1998

83. YEAR 2000 COMPLIANCE

a. In accordance with FAR 39.106, the Contractor shall ensure that with respect to any design, construction, goods, or services under this contract as well as any subsequent task/delivery orders issued under this contract (if applicable), all information technology contained therein shall be Year 2000 compliant. Specifically:

b. The Contractor shall:

(1) Perform, maintain, and provide an inventory of all major components to include structures, equipment, items, parts, and furnishings under this contract and each task/delivery order which may be affected by the Y2K compliance requirements.

(2) Indicate whether each component is currently Year 2000 compliant or requires an upgrade for compliance prior to government acceptance.

GENERAL DECISION VA980003 05/22/98 VA3
General Decision Number VA980003

Superseded General Decision No. VA970003

State: Virginia

Construction Type:
BUILDING

County(ies):
NEWPORT NEWS*

*INDEPENDENT CITY OF NEWPORT NEWS (INCLUDING FORT EUSTIS)

BUILDING CONSTRUCTION PROJECTS (Does not include single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	02/13/1998
1	05/22/1998

COUNTY(ies):
NEWPORT NEWS*

ELEC1340A 12/01/1997

	Rates	Fringes
ELECTRICIANS	17.05	3.86

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* ENGI0147I 05/01/1998

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
Cranes, Under 90 tons	17.73	4.58
Fork Lift	14.18	4.58

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* IRON0079G 05/01/1998

	Rates	Fringes
IRONWORKERS, STRUCTURAL	17.20	4.65+9%

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* PLUM0540B 05/01/1998

	Rates	Fringes
PLUMBERS & PIPEFITTERS	18.70	5.50

SUVA1036A 05/01/1993

	Rates	Fringes
ACOUSTIC CEILING MECHANICS	12.50	
BRICKLAYERS	15.32	
CARPENTERS, (Including Drywall Hanging; Excluding Acoustic Ceiling Installation)	12.22	1.86
CEMENT MASONS	11.20	
DRYWALL FINISHERS	11.50	
LABORERS:		

Unskilled	6.65	
Mason Tenders, Brick	6.76	
Mortar Mixers	6.75	
PAINTERS, (Excluding Drywall Finishing)	9.19	
PIPE INSULATORS	9.25	
POWER EQUIPMENT OPERATORS:		
Backhoes	10.50	
Bulldozers	10.00	.57
Loaders	10.19	
ROOFERS	10.30	
SHEET METAL WORKERS	11.85	
SPRINKLER FITTERS	15.18	1.99
TRUCK DRIVERS	7.31	

WELDERS - Receive rate prescribed for craft performing

operation to which welding is incidental.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(v)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations

Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor

200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

STATEMENT AND ACKNOWLEDGMENT

FORM APPROVED OMB NO
9000-0014

Public reporting burden for this collection of information is estimated to average .15 hours per response, including the time for reviewing instructions. Searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the suggestions for reducing this burden, to the FAR Secretarial (VRS), Office of Federal Acquisition and Regulatory Policy, GSA Washington, D.C. 20405: and to the Office of Management and Budget, Paperwork Reduction Project (9000-0014), Washington, D.C. 20503

PART I - STATEMENT OF PRIME CONTRACTOR

1. PRIME CONTRACT NO.	2. DATE SUBCONTRACT AWARDED	3. SUBCONTRACT NUMBER

4. PRIME CONTRACTOR (Name, address and ZIP code)	5. SUBCONTRACTOR (Name, address and ZIP code)

6. The prime contractor states that under the contract shown in item 1, a subcontract was awarded on date shown in item 2 by (Name of Awarding Firm)

to the subcontractor identified in item 5, for the following work:

7. PROJECT	8. LOCATION	
9. NAME AND TITLE OF PERSON SIGNING	10. BY (Signature)	11. DATE SIGNED

PART II - ACKNOWLEDGMENT OF SUBCONTRACTOR

12. The subcontractor acknowledges that the following clauses of the contract shown in item 1 are included in this subcontract:

Contract Work Hours and Safety Standards Act - Overtime Compensation - Construction	David-Bacon Act
Payrolls and Basic Records	Apprentices and Trainees
Withholding of Funds	Compliance with Copeland Regulations
Disputes Concerning Labor Standards	Subcontracts
	Contract Termination-Debarment
	Certification of Eligibility

13. NAME(S) OF ANY INTERMEDIATE SUBCONTRACTORS, IF ANY

14. NAME AND TITTLE OF PERSON SIGNING	15. BY (Signature)	16 DATE SIGNED

24 October 1988

(Sample of Typical contractor Quality report)

CONTRACTOR'S NAME
(Address)

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Contract No:_____ Date:_____ Report No._____
Project Name_____
Weather: (Clear) (P. Cloudy) (Cloudy); Temperature: ____Min.____Max; ____Rainfall ____in.

Contractor/Subcontractors/Supplier	Area of Responsibility
a.	
b.	
c.	
d.	
e.	
f.	
g.	

1. Definable Features of Construction in Progress: (Give briefly only definable features of work in progress and location. Refer to work performed by prime and/or subcontractor and/or supplier by letter in table above).

2. Material and/or Equipment Delivered to site:

3. Results of Surveillance:

Preparatory Phase (Attach minutes):

Initial Phase (Attach minutes):

Follow-up Phase (Include satisfactory work completed and/or deficiencies with action to be taken):

4. Tests Required by Plans and/or Specification Performed and results of Test:
(Attach results of test taken on previous dates).

5. Verbal Instructions Received: (List any instructions given by Government Personnel on construction deficiencies. Retesting required, etc., with action to be taken.

6. Safety Deficiencies Noted. (Describe corrective actions taken).

7. Remarks: (Cover any conflicts in plans, specifications, or instruction).

CONTRACTOR'S VERIFICATION: The above report is complete and correct and all material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

Contractor's Authorized QC Representative

SUBMITTAL REGISTER

(ER 415-1-10)

CONTRACT NO.:

TITLE AND LOCATION

CONTRACTOR:

SPECIFICATION SECTION:

ACTIVITY NO	TRANS-MITTAL NO.	ITEM NO	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
					DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	O&M MANUALS	INFORMATION ONLY	GOVERNMENT APPROVED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE	SUBMIT TO GOVERN-MENT	CODE	DATE	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	aa

ENG FORM 4288-R, JAN 97 **EDITION OF MAR 95 IS OBSOLETE.** PAGE ____ OF ____ PAGES (Proponent: CEMP-CE)

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE *(Read instructions on the reverse side prior to initiating this form)*	DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____
SPECIFICATION SEC. NO. *(Cover only one section with each transmittal)*	PROJECT TITLE AND LOCATION		CHECK ONE: THIS TRANSMITTAL IS FOR FIO ☐ GOV'T ☐ APPROVAL

ITEM NO. a.	DESCRIPTION OF ITEM SUBMITTED *(Type size, model number/etc.)* b.	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See Instruction no. 8) c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT SPEC. PARA. NO. e.	DRAWING SHEET NO. f.	FOR CONTRACTOR USE CODE g.	VARIATION (See instruction no. 6) h.	FOR CE USE CODE i.

REMARKS	I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED *(List by Item No.)*	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

Instructions

1. Section I will be initiated by the contractor in the required number of copies.

2. Each transmittal shall be numbered consecutively in the space provided for “Transmittal No.”. This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; in resubmittals, insert transmittal number of last submission as well as the new submittal number.

3. The “Item No.” will be the same “Item No.” as indicated on ENG FORM 4288-R for each entry on this form.

5. Separate transmittal form will be used for submittals under separate section of the specifications.

6. a check shall be placed in the “Variation” column when a submittal is not in accordance with the plans and specifications—also, a written statement to that effect shall be included in the space provided for “Remarks.

7. Form is self-transmittal, letter of transmittal is not required.

8. When a sample of material or Manufacturer’s Certificate of Compliance is transmitted, indicate “Sample” or “Certificate” in column c, Section I.

9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g. to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A – Approved as submitted.

B – Approved, except as noted on drawings.

C – Approved, except as noted on drawings. Refer to attached sheet resubmission required.

D – Will be returned by separate correspondence.

E – Disapproved (See attached).

F – Receipt acknowledged.

FX – Receipt acknowledged, does not comply as noted with contract requirements.

G – Other *(Specify)*

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

(Reverse of ENG form 4025-R)

EQUIPMENT-IN-PLACE LIST

Contract No._____

Description of Item:_____

Model No:_____

Serial No:_____

Capacity:_____

Name of Mfg:_____

Condition:_____

Checked by:_____Replacement Cost_____

Description of Item:_____

Model No:_____

Serial No:_____

Capacity:_____

Name of Mfg:_____

Condition:_____

Checked by:_____Replacement Cost_____

Description of Item:_____

Model No:_____

Serial No:_____

Capacity:_____

Name of Mfg:_____

Condition:_____

Checked by:_____Replacement Cost_____

(If Para. 10 is used, use this form)

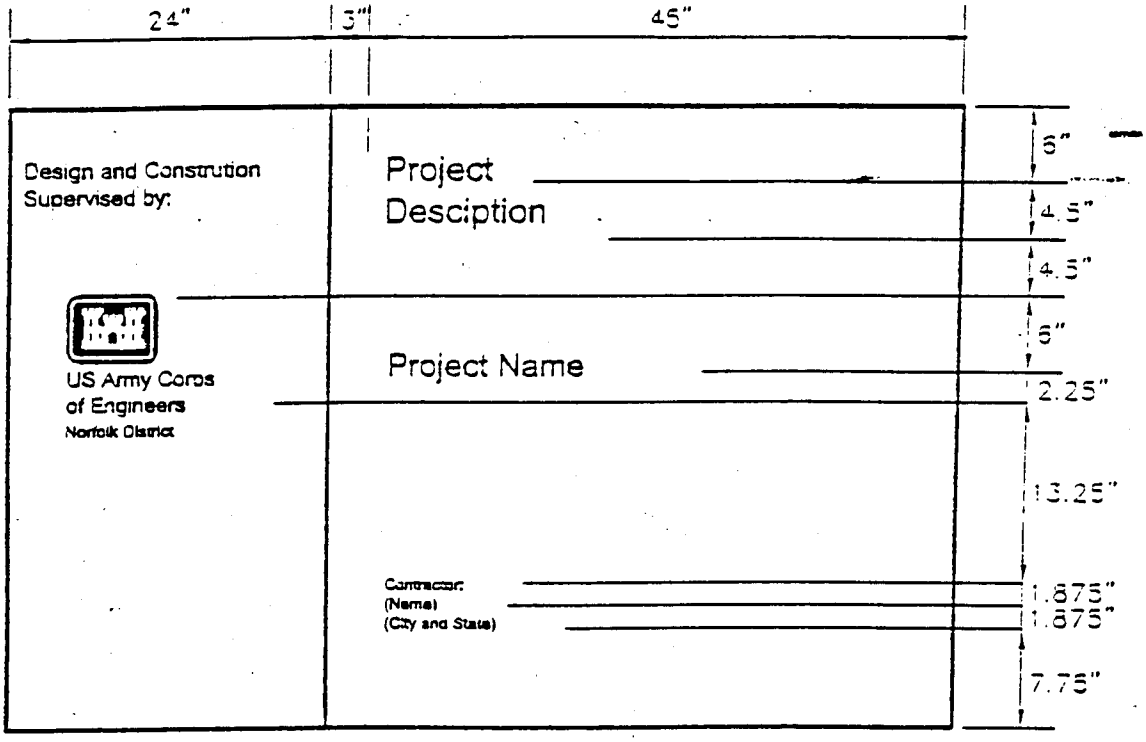
DEFICIENCY LIST

CONTRACT NUMBER:_____ PROJECT: _____

		DEFICIENCY		CORRECTION		
DEFIC. NO.	DESCRIPTION	DATE OBSERVED	CQC REPORT NO.	DATE CORRECTED	CQC REPORT NO.	COMMENTS

PROJECT SIGN

The graphic format for this 4'x6' sign panel follows the legend guidelines and layout as specified below. The large 4'x4' section of the panel on the right is to white with black legend. A 2'x4' decal provided by the Corps shall be placed on the left side of the sign panel.



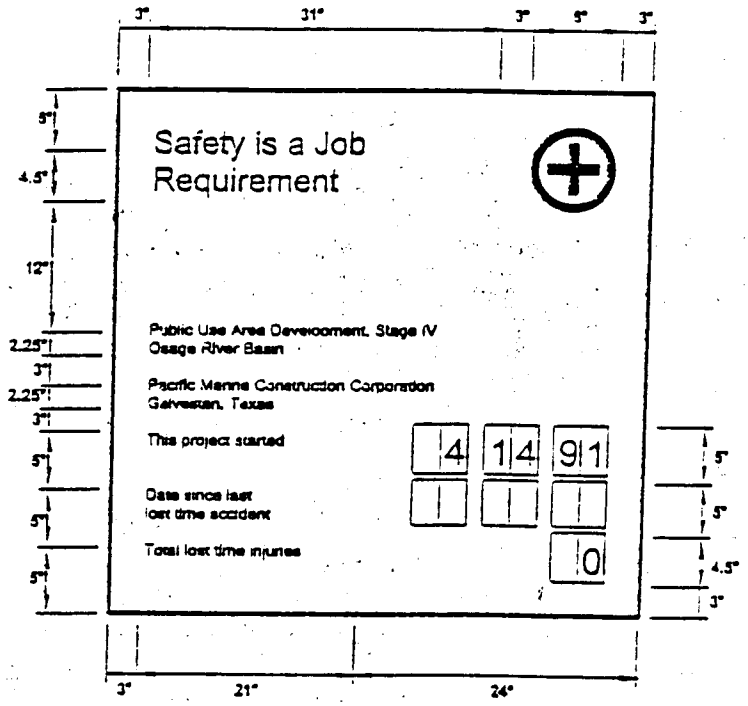
Project Description:
One to three line project title legend describes the work being done under this contract.
Color: Black; Typeface: 3" Helvetica Bold; Maximum line length: 42"

Project Name:
One to three line identification of project or facility.
Color: Black; Typeface 1.5" Helvetica Bold; Maximum line length: 42"
Cross-align the first line of PROJECT NAME with the first line of the Corps Signature as shown.

Contractor:
One to five line identification of prime contractors including: type(architect, general contractor, etc.), corporate or firm name, city, state.
Color: Black; Typeface: 1.25" Helvetica Bold; Maximum line length: 21"

All typography is flush left and ragged right, upper and lower case with initial capitals only as shown.
Letter and word spacing to follow Corps Standards (EP 310-1-6a and 6b).

SAFETY SIGN



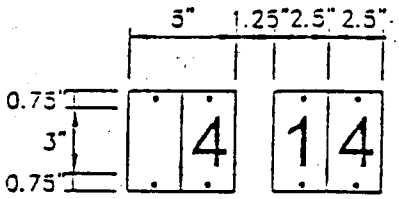
All typography is flush left and rag right, upper and lower case with initial capitals only as shown. Letter and word spacing to follow Corps Standards (EP 310-1-6a and 6b).

Legend Group 1: Standard two-line title "Safety is a Job Requirement" with (8" od.) Safety Green First Aid logo. Typeface: 3" Helvetiva Bold; Color: Black.

Legend Group 2: One to two-line project title legend describes the work being done under this contract and name of host project. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

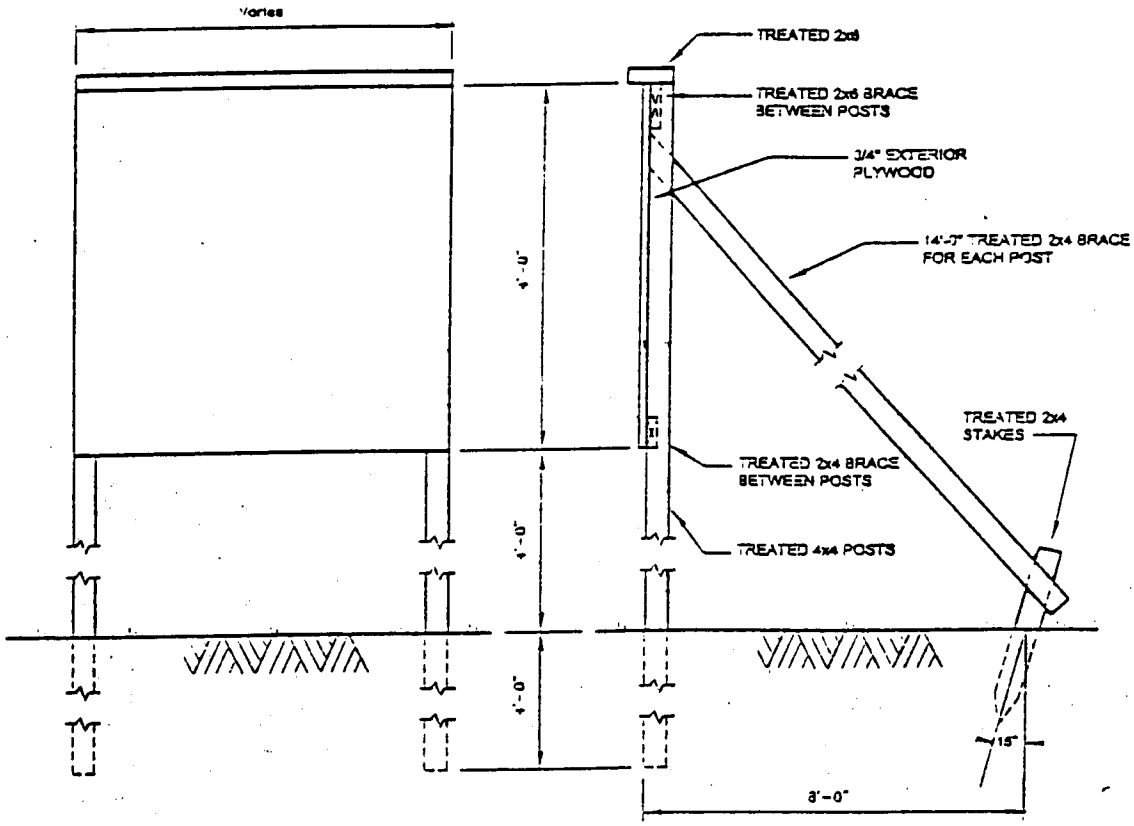
Legend Group 3: One to two-line identification: name of prime contractor and city, state address. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

Legend Group 4: Standard safety record captions as shown. Typeface 1.25" Helvetica Regular; Color: Black.



Replaceable numbers are to be mounted on white 0.060 aluminum plates and screw-mounted to backdrop. Typeface: 3" Helvetica Regular; Color: Black; Plate size: 2.5"x 4.5".

SIGN ERECTION DETAILS



SECTION 01005

PROJECT WORK REQUIREMENTS AND RESTRICTIONS

03/98

PART 1 GENERAL

1.1 DEFINITIONS

a. Facility: The facility is an Aviation Support Facility located at Fort Eustis, Virginia.

b. CO: Contracting Officer or his authorized representative.

1.3 COOPERATION WITH USING AGENCY AND OTHER CONTRACTORS

During the period of this contract, other contracts may be in force for the construction of other features of work on or adjacent to the site of work being accomplished under this contract. It shall be the responsibility of the Contractor on this contract to be fully informed of the extent of the limits of work to be performed by other Contractors. Should there be any conflict between these limits, it shall be brought to the attention of the Contracting Officer and the CO's decision shall be final. Also, prior to completion of work under this contract, members of the Using Agency may be performing work or occupying facilities on or adjacent to the area. The Contractor shall arrange his plant and shall schedule and perform this work so as to effectively cooperate with all other Contractors and Government agencies.

1.4 PERSONNEL RESTRICTIONS

Personnel are limited to the immediate site areas and shall not enter buildings or facilities not involved in the work. All employees of the Contractor will be subject to all rules and regulations of the Facility which pertain to personnel. The Contractor shall erect fences and signs as specified and be responsible for the restrictions of all personnel. The Contractor's plans for restricting personnel access to the project site shall be submitted for approval as a part of the Safety Plan (Accident Prevention Plan).

1.5 TRANSPORTATION FACILITIES

The Facility is served by an all weather surfaced road network. Road(s) within the Facility proposed to be used by the Contractor shall be subject to prior approval of the Facility authorities and such roads, if used, shall be maintained throughout construction and shall be restored to as good condition as existed prior to their use. The Contractor shall also construct, subject to approval, such temporary haul roads and bridges as may be necessary for conducting his work. Any such temporary construction shall be removed and the affected area restored to its original condition. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration shall be borne by the Contractor.

1.5.1 Use of Roads

The Contractor shall keep all roads clear of all obstructions and free of mud and other foreign materials resulting from operations. The Contractor's vehicles shall at no time follow a vehicle closer than 50 feet, and all vehicles shall pull off the road and come to a complete stop when meeting

emergency vehicles and vehicles with flashing lights. Facility speed limits and traffic controls will be observed.

1.5.2 Road Restrictions

The movement of all vehicles within the Facility shall be confined to the roads designated and shall comply with traffic regulations within the Facility. Other roads may be used only with the approval of the CO.

1.5.2.1 Cleated Vehicles

Cleated vehicles shall not be moved over surfaced roads except at the immediate site of the area where they are to be used.

1.6 COORDINATION IN WORK AREAS

1.6.1 Unoccupied Work Area

The area where the Contractor is scheduled to perform the work will not be occupied during the work; however, the Contractors work activities may affect other area(s) that are occupied. All work shall be in accordance with the Contractor's work plan.

1.6.2 Maintenance of Utilities

Any active utilities, including but not limited to electricity, gas, water, sewer, heating, air conditioning, or any like service, that will require interruption or replacement in any occupied area affected as a result of the Contractors scheduled work activities, shall be temporarily provided by the Contractor at his own expense until the affected service is fully and permanently restored. All temporary method(s) of service replacement the Contractor proposes for use on this contract shall be approved by the Contracting Officer prior to commencing the work.

1.6.3 Hours of Work

The normal work hours for construction shall be from 8:00 a.m. to 4:30 p.m., Monday through Friday of each week. Any request to change these hours shall be made in writing to the Contracting Officer at least two calendar days prior to the desired day on which the change is to go into effect. The changed hours shall not go into effect until written permission has been received from the Contracting Officer.

1.6.5 Digging Permits

Contractor is responsible for obtaining all digging permits, including associated locating and marking services, in accordance with installation and local requirements, at no additional cost to the Government. The Contractor shall obtain a "Clearance Permit for Digging" from the DPW Technician in Building 1407, Phone (757) 878-3190, ext. 261, and shall fill in the pertinent information. The completed form shall then be submitted to the technician with an accurate sketch showing where work needs to be performed and what, if any, utilities are to be installed. After submitting the completed "Clearance Permit for Digging", the technician shall coordinate a site meeting for the contractor with the Government's utilities locating contractor. Utilities located and marking, required for the digging permits, shall be obtained by the Contractor, at his own cost, using the Government's utilities locating contractor.

The Contractor shall be charged for the utilities locating and marking services at the Government rate of $95.00 per hour (subject to yearly change) and shall be billed by the Government locating contractor directly for those services.

1.7 INTERRUPTIONS OF UTILITIES

1.7.1 Approval

Utility services shall not be interrupted by the Contractor to relocate, make connections, or interrupt for any purpose, without written approval of the Contracting Officer.

1.7.2 Request

Request for permission to shut down services shall be submitted in writing to the Contracting Officer not less than 10 calendar days prior to date of proposed interruption. The request shall give the following information:

a. Nature of Utility (Gas, L.P. or H.P., Water, Elec.)

b. Size of line and location of shutoff.

c. Buildings and services affected.

d. Hours and date of shutoff.

e. Estimated length of time service will be interrupted.

1.7.3 Service Interruptions

Services shall not be shut off until receipt of approval of the proposed hours and date from the Contracting Officer.

1.7.4 Timely Disconnections

Shutoffs which will cause interruption of Government work operations as determined by the Contracting Officer shall be accomplished during regular non-work hours or non-work days of the Using Agency without any additional cost to the Government.

1.7.5 Utilities Operation

Operation of valves on water mains will be by Government personnel. Where shutoff of water lines interrupts service to fire hydrants or fire sprinkler systems, the Post Fire Department shall be notified by the Contractor in writing 72 hours prior to the proposed interruption. The Contractor shall arrange his operations and have sufficient material and personnel available to complete the work without undue delay and shall restore service without delay in event of emergency.

1.7.6 Gas

Flow in gas mains which have been shut off shall not be restored until the Government inspector has determined that all items serviced by the gas line have been shut off.

1.8 PHYSICAL DATA

The physical conditions indicated on the drawings and in the specifications are the result of site visits, surveys and borings. See Section 01055 SOIL BORING DATA for boring logs and data.

1.9 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the Contract Clause entitled "Default: (Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

a. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

1.9.1 Schedule

The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fort Eustis	10	9	8	6	7	7	9	6	5	5	6	9

1.9.2 Records

Upon acknowledgement of the Notice to Proceed and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

1.9.3 Impacted Days

The number of actual adverse weather days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day in each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in the schedule of monthly anticipated adverse weather delays, above, the contracting officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the Contract Clauses entitled "Default (Fixed Price Construction)".

1.10 NOT USED

1.11 SITE CONTAMINATION

1.11.1 Compliance Requirements

The Contractor shall comply with applicable Federal, state and local laws, codes, ordinances and regulations (including the obtaining of licenses and permits) in connection with any hazardous material, substance or waste.

1.11.2 Requirements

The requirements of this clause and any act or failure to act by the Government shall not relieve the Contractor of any responsibility or liability for the safety of Government, Contractor or subcontractor personnel or property.

1.11.3 Contamination

In the event that contamination beyond that shown or specified is encountered, the Contracting Officer shall be advised immediately. The contamination shall be removed as directed and replaced with satisfactory material. Payment therefor will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES.

1.12 WORK IN QUARANTINED AREA

The work called for by this contract involves activities in counties quarantined by the Department of Agriculture to prevent the spread of certain plant pests which may be present in the soil. The Contractor agrees that all construction equipment and tools to be moved from such counties shall be thoroughly cleaned of all soil residues at the construction site with water under pressure and that hand tools shall be thoroughly cleaned by brushing or other means to remove all soil. In addition, if this contract involves the identification, shipping, storage, testing, or disposal of soils from such a quarantined area, the Contractor agrees to comply with the provisions of ER 1110-1-5 and attachments, a copy of which will be made available by the Contracting Officer upon request. The Contractor agrees to assure compliance with this obligation by all subcontractors.

1.13 HISTORICAL AND ARCHAEOLOGICAL FINDS

Federal legislation provides for the protection, preservation, and collection of scientific, prehistorical, historical, and archaeological data, including relics and specimens which might otherwise be lost due to alteration of the terrain or building features as a result of any Federal construction project. Should the Contractor, or any of the Contractor's employees, or parties operating or associated with the Contractor, in the performance of this contract discover evidence of possible scientific, prehistorical, historical, or archaeological data, the Contractor shall immediately cease work at that location and notify the Contracting Officer, giving the location and nature of the findings. The Contractor shall forward written confirmation to the Contracting Officer as directed. The Contractor shall exercise care so as not to disturb or damage artifacts or fossils uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition. Any person who, without permission, injures, destroys, excavates, appropriates, or removes any historical or prehistorical artifact, object of antiquity, or archaeological resource on

the public lands of the United States is subject to arrest and penalty of law. Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

1.14 EQUIPMENT-IN-PLACE LIST:

The Contractor shall maintain a list of equipment installed under the terms of the contract. In the event that the contract includes more than one building or facility, a list must be maintained for each and delivered to the Contracting Officer upon acceptance of each building or facility. Forms to be used for this purpose shall be obtained from the Area Engineer's Office. The list shall include the following:

a. Contract number
b. Description of item
c. Model number
d. Serial number
e. Capacity
f. Name of manufacturer
g. Address of manufacturer
h. Condition of item
i. Replacement cost
j. Name of person who checked item

1.15 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

1.15.1 Allowable Costs

Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a Contractor or subcontractor at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region II. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

1.15.2 Rental Costs

Equipment rental costs are allowable, subject to the applicable provisions of the Federal Acquisition Regulations, and shall be substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-leaseback arrangements will be determined using the schedule except that rental costs leased form an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

1.15.3 Equipment Costs

When actual equipment costs are proposed and the total amount of the pricing action is over $25,000, cost or pricing data shall be submitted on the Standard Form 1411, "Contract Pricing Proposal Cover Sheet". By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

1.15.4 Marine Equipment

In determining the ownership expense for marine equipment as described in the Schedule, the average use per year shall be 8 months.

1.16 SUBCONTRACTS AND WORK COORDINATION

Contract Clauses "SUBCONTRACTS", "PERMITS AND RESPONSIBILITIES", and "MATERIAL AND WORKMANSHIP" are supplemented as follows:

a. Divisions or sections of specifications are not intended to control the Contractor in dividing the work among subcontractors, or to limit work performed by any trade.

b. Contractor shall be responsible for coordination of the work of the trades, subcontractors, and materials.

c. The Government or its representative will not undertake to settle any difference between the Contractor and Contractor's subcontractors, or between subcontractors.

d. The Government reserves the right to refuse to permit employment on the work or require dismissal from the work of any subcontractor who, by reason of previous unsatisfactory work on Corps of Engineers projects, or for any other reason is considered by the Contracting Officer to be incompetent or otherwise objectionable.

1.17 CONSTRUCTION MANPOWER AND EQUIPMENT REPORT

The Contractor shall submit executed CENAO Form 987, Construction Manpower and Equipment Report daily. The report shall include manpower and equipment for the general and subcontractors. Forms are available from the Contracting Officer.

1.18 PURCHASE ORDERS

To ensure proper expediting of orders the Contractor and his subcontractors shall furnish to the Contracting Officer, one copy of each purchase order covering supplies or services required for performance of the work. Each purchase order shall clearly indicate the date of placement, the date delivery is required in order to avoid delay in the scheduled progress of the work, and the date delivery is promised by the supplier or producer. Copies of purchase orders shall be forwarded on the date issued.

1.19 PROFIT

1.19.1 Weighted Guidelines

Weighted guidelines method of determining profit shall be used on any equitable adjustment change order or modification issued under this contract. The profit factors shall be as follows:

Factor	Rate	Weight	Value
Degree of Risk	20		
Relative difficulty of work	15		
Size of Job	15		
Period of performance	15		
Contractor's investment	05		
Assistance by Government	05		
Subcontracting	25		
	100		

1.19.2 Value

Based on the circumstances of each procurement action, each of the above factors shall be weighted from .03 to .12 as indicated below. The value shall be obtained by multiplying the rate by the weight. The value column when totalled indicates the fair and reasonable profit percentage under the circumstances of the particular procurement.

1.19.2.1 Degree of Risk

Where the work involves no risk or the degree of risk is very small, the weighting should be .03; as the degree of risk increases, the weighting should be increased up to a maximum of .12. Lump sum items will have, generally, a higher weighted value than the unit price items for which quantities are provided. Other things to consider: the portion of the work to be done by subcontractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, and whether the negotiation is before or after performance of work.

1.19.2.2 Relative Difficulty of Work

It the work is most difficult and complex, the weighting should be .12 and should be proportionately reduced to .03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider: the nature of the work, by whom it is to be done, where, and what is the time schedule.

1.19.2.3 Size of Job

All work not in excess of $100,000 shall be weighted at .12. Work estimated between $100,000 and $5,000,000 shall be proportionately weighted from .12 to .05.

1.19.2.4 Periods of Performance

Jobs in excess of 24 months are to be weighted at .12. Jobs of lesser duration are to be proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. No weight where additional time not required.

1.19.2.5 Contractor's Investment

To be weighted from .03 to .12 on the basis of below average, average, and above average. Things to consider: amount of subcontracting, mobilization payment item, Government furnished property, equipment and facilities, and expediting assistance.

1.19.2.6 Assistance by Government

To be weighted from .12 to .03 on the basis of average to above average. Things to consider: use of Government owned property, equipment and facilities, and expediting assistance.

1.19.2.7 Subcontracting

To be weighted inversely proportional to the amount of subcontracting. Where 80 percent or more of the work is to be subcontracted, the weighting is to be .03 and such weighting proportionately increased to .12 where all the work is performed by the Contractor's own forces.

PART 2 PRODUCTS (THIS PART NOT USED)

PART 3 EXECUTION (THIS PART NOT USED)

-- End of Section --

SECTION 01055
SOIL BORING DATA

1. GENERAL: The following pages are copies of dilatometer push logs labeled 270DP-1 through 270DP-6, representing the July 1997 subsurface investigations at the project site.

2. EXPLORATION LOCATIONS: Exploration locations are shown on the contract drawings.

3. CHARACTER OF MATERIALS: The soil boring data are included for information only. Each log is believed to show the nature of the materials encountered at that specific location and to the depth indicated on the log; the listed water depth is an estimate only, and soil and water conditions vary between explorations. The attached logs and construction experience indicate that perched water conditions are commonly encountered at shallow depths at Fort Eustis. Proper drainage is required for all excavations and earthwork; dewatering shall be expected for utility and other excavations extending below a depth of 7 feet from the existing ground surface during dry periods, and at any depth during and after rainy periods. Unstable soil conditions, resulting in delay to construction activity, shall also be expected during and after rainy periods.

4. EXPLORATION NOTES:

4.1 Explorations 270DP-1 through 270DP-6 were performed in accordance with FHWA-SA-91-044, The Flat Dilatometer Test.

4.1.1 Soils (ML, CL, GP, etc.) are classified in accordance with "In-Situ Tests by Flat Dilatometer" by Marchetti, Journal of the Geotechnical Engineering Division, ASCE, March 1980. The data was reduced using "Dilly 4" (Data Reduction Computer Program), by Paul Bullock, Schertmann and Crapps, Inc., 1982.

4.2 All elevations and locations are approximate.

4.3 Abbreviations applicable to the dilatometer sounding logs are provided on page 2 of this specification section.

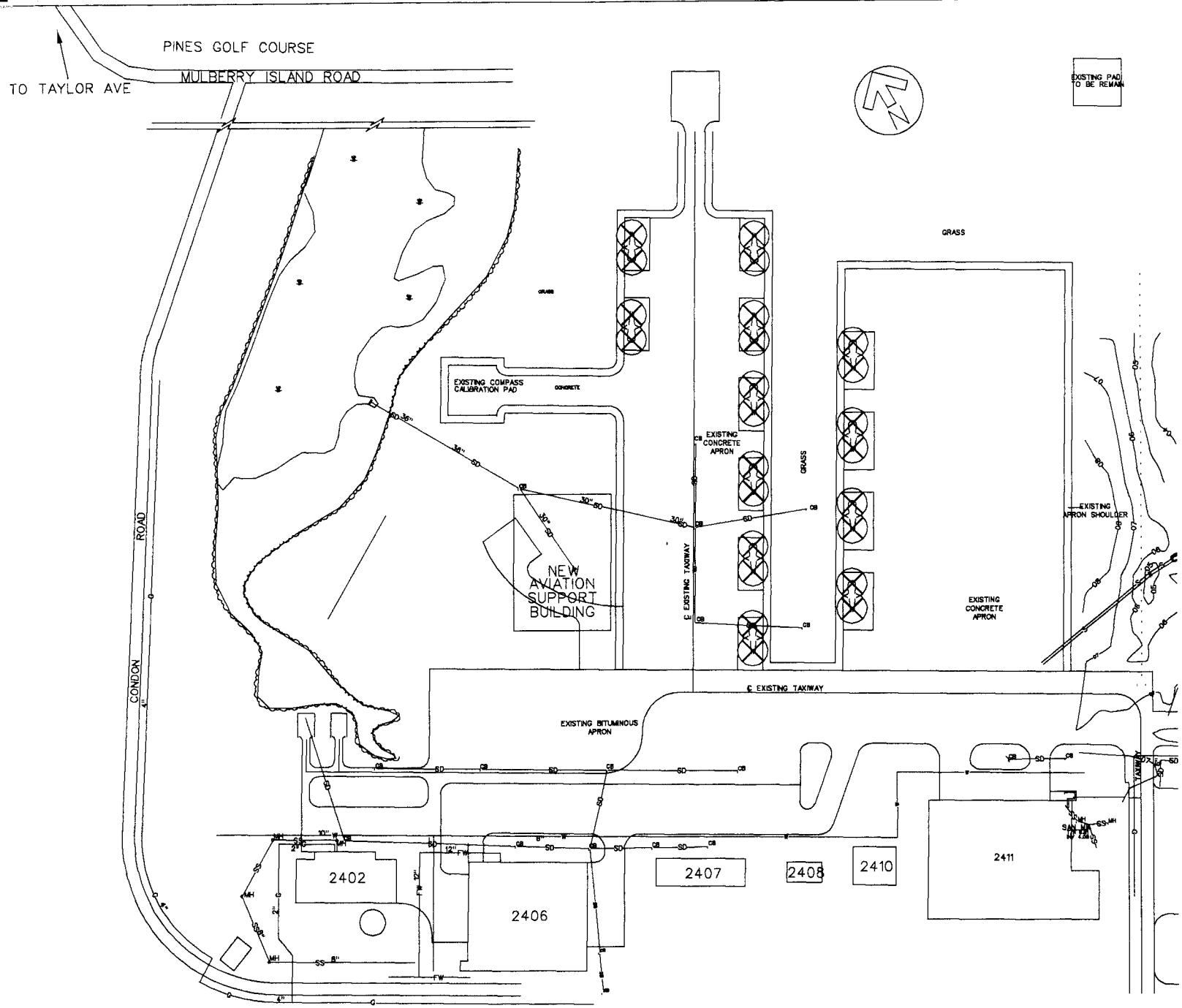
3. DMT OUTPUT GUIDE

The DMT BASIC program is used at GPE Inc. to reduce Dilatometer field data. Output from the program is grouped into two categories: tabulated information and plotted information. The tabular output is printed first and consists of a heading and the parameters listed below. Only the parameters preceded by an "*" are provided on the abbreviated one-page output. The heading contains information about the test (location, date, etc.), calibrations and the type of analysis procedures used.

Parameter	Units	Description
* Z	Meters	Test reading depth
* THRUST	Kgf	Total thrust force needed to advance the blade
* A	Bars	Dilatometer control unit "A" reading
* B	Bars	Dilatometer control unit "B" reading
* C	Bars	Dilatometer control unit "C" reading
DA	Bars	Dilatometer A-calibration
DB	Bars	Dilatometer B-calibration
ZMRNG	Bars	Maximum control unit reading on low range gage
ZMLO	Bars	Gage zero for low range gage
ZMHI	Bars	Gage zero for high range gage
ZMCAL	Bars	Gage zero for calibration gage
PO	Bars	Corrected "A" reading, p_0
P1	Bars	Corrected "B" reading, p_1
P2	Bars	Corrected "C" reading, p_2
* UO	Bars	Porewater pressure
* GAMMA	T/M^3	Total unit weight of soil
* SVP	Bars	Effective vertical stress
* KD	-	Dilatometer horizontal stress index
* ID	-	Dilatometer material index
UD	-	Proposed pore pressure index
* ED	Bars	Dilatometer modulus
* KO	-	Insitu coefficient of lateral earth pressure
* SU	Bars	Undrained shear strength for $I_D \leq 0.6$
QD	Bars	DMT bearing capacity from PHI calculation
* PHI	Degrees	The soil's drained plane strain friction angle (Ø') for $I_D \geq 1.2$.
SIGFF	BARS	Failure plane stress used to calculate PHIO
PHIO	Degrees	PHI normalized to 2.72 bars, Baligh's theory
* PC	Bars	Preconsolidation pressure
* OCR	-	Overconsolidation ratio
* M	Bars	Tangent drained constrained modulus
* SOIL TYPE	-	Type of soil (clay, sand, etc.)

If problems are encountered upon reduction of the input data, the tabulated output will contain information indicating this. These problems usually center around the calculation of p_0 (the corrected "A" reading) and the soil I_D.

FILMED 1 VIRGINIA MAP
AVIATION SUPPORT FACILITY
FORT EUSTIS, VIRGINIA
HILLER ARMY AIRFIELD
FEB 11 SAT

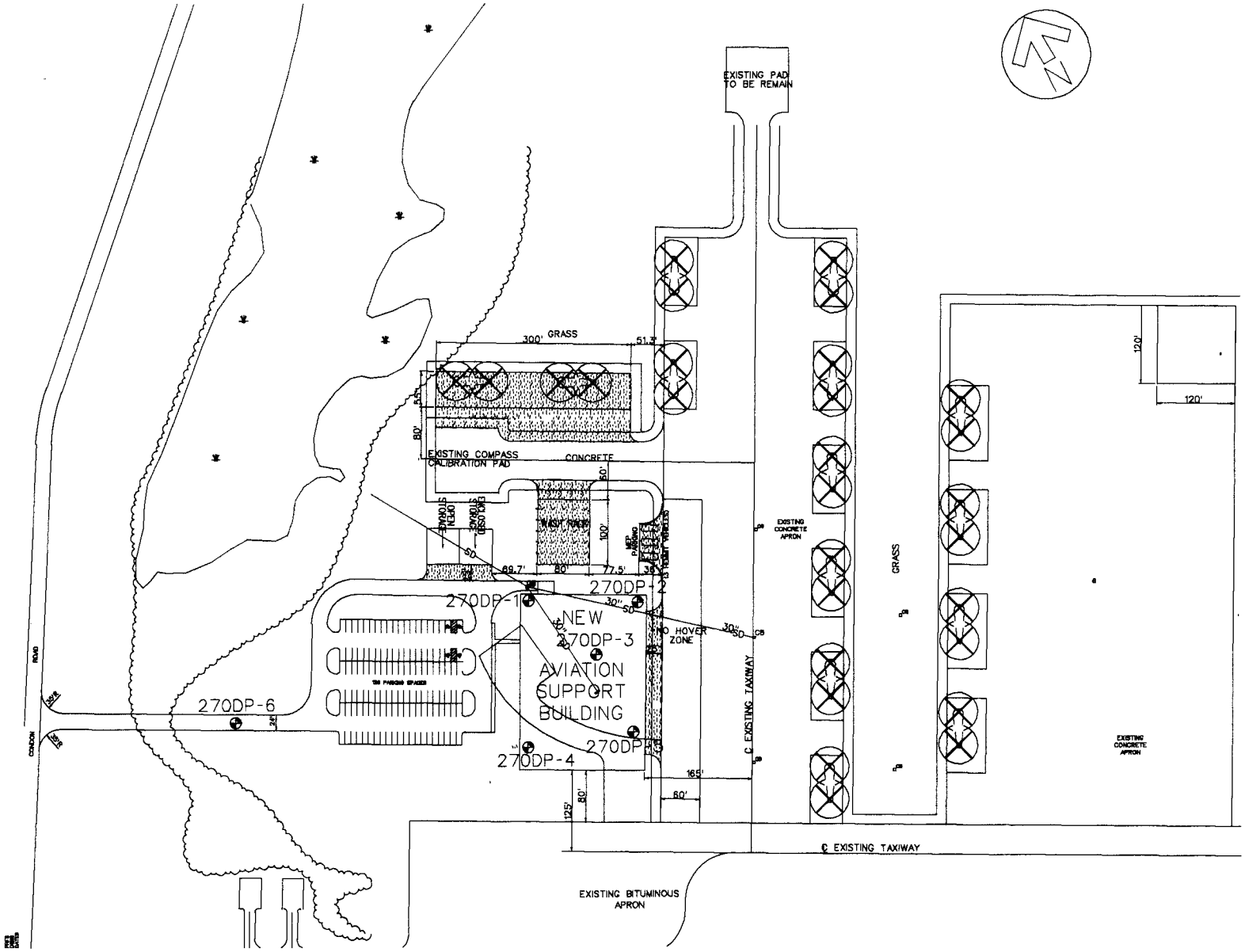


FELKER ARMY AIRFIELD

NOT TO SCALE

AVIATION SUPPORT FACILITY
FORT EUSTIS, VIRGINIA

PROJECT VICINITY MAP



SCALE: 1"=250'-0"

0 25' 50' 100' 150' 200' 250'

AVIATION SUPPORT FACILITY
FORT EUSTIS, VIRGINIA

EXPLORATION PLAN

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. 270DP-1
IN-SITU SOIL TESTING, L.C. PAGE 1
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA FILE NO. : IST-9716
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER SNDG.DATE: 7-2-97
ANAL.BY : R. FAILMEZGER ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS: LO RANGE = 9.98 BARS ROD DIAM. = 3.57 CM BL.THICK. = 15.0 MM SU FACTOR = 1.00
SURF.ELEV. = 5.00 M LO GAGE 0 = 0.04 BARS FR.RED.DIA. = 4.80 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1.00
WATER DEPTH = 2.30 M HI GAGE 0 = 0.10 BARS LIN.ROD WT. = 6.50 KGF/M DELTA-A = 0.19 BARS OCR FACTOR = 1.00
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.50 DELTA-B = 0.16 BARS M FACTOR = 1.00
MAX SU ID = 0.60 SU OPTION = MARCHETTI MIN PHI ID = 1.20 OCR OPTION= MARCHETTI KO FACTOR = 1.00
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.20	3620.	6.18	28.80		0.19	0.16	9.98	0.04	0.10	0.00	5.22	28.54		0.000	2.00	0.035
0.40	6620.	11.50	33.00		0.19	0.16	9.98	0.04	0.10	0.00	10.53	32.74		0.000	2.15	0.076
0.60	4740.	8.83	22.70		0.19	0.16	9.98	0.04	0.10	0.00	8.31	22.44		0.000	1.95	0.116
0.80	2700.	5.50	16.35		0.19	0.16	9.98	0.04	0.10	0.00	5.13	16.09		0.000	2.00	0.155
1.00	1760.	4.06	10.45		0.19	0.16	9.98	0.04	0.10	0.00	3.91	10.19		0.000	1.80	0.192
1.20	1440.	4.39	9.52		0.19	0.16	9.98	0.04	0.10	0.00	4.30	9.32		0.000	1.80	0.227
1.40	1410.	6.68	14.45		0.19	0.16	9.98	0.04	0.10	0.00	6.46	14.19		0.000	1.95	0.264
1.60	1350.	6.42	13.45		0.19	0.16	9.98	0.04	0.10	0.00	6.24	13.19		0.000	1.95	0.302
1.80	1380.	6.42	14.00		0.19	0.16	9.98	0.04	0.10	0.00	6.21	13.74		0.000	1.95	0.341
2.00	1370.	6.79	13.85		0.19	0.16	9.98	0.04	0.10	0.00	6.61	13.59		0.000	1.95	0.379
2.20	970.	4.62	6.63		0.19	0.16	9.98	0.04	0.10	0.00	4.69	6.43		0.000	1.80	0.416
2.40	1160.	2.70	6.45		0.19	0.16	9.98	0.04	0.10	0.00	2.68	6.25		0.010	1.80	0.441
2.60	1990.	3.21	10.35		0.19	0.16	9.98	0.04	0.10	0.00	3.02	10.09		0.029	1.90	0.458
2.80	2290.	2.67	10.15		0.19	0.16	9.98	0.04	0.10	0.00	2.47	9.89		0.049	1.90	0.476
3.00	2550.	3.88	12.90		0.19	0.16	9.98	0.04	0.10	0.00	3.60	12.64		0.069	1.90	0.493
3.20	2210.	3.03	10.35		0.19	0.16	9.98	0.04	0.10	0.00	2.83	10.09		0.088	1.90	0.511
3.40	1770.	2.04	8.05		0.19	0.16	9.98	0.04	0.10	0.00	1.91	7.85		0.108	1.80	0.528
3.60	1700.	1.96	8.16		0.19	0.16	9.98	0.04	0.10	0.00	1.82	7.96		0.128	1.80	0.543
3.80	2210.	1.91	8.51		0.19	0.16	9.98	0.04	0.10	0.00	1.75	8.31		0.147	1.80	0.559
4.00	2960.	2.97	12.75		0.19	0.16	9.98	0.04	0.10	0.00	2.65	12.49		0.167	1.90	0.576
4.20	2090.	2.60	10.45		0.19	0.16	9.98	0.04	0.10	0.00	2.38	10.19		0.186	1.90	0.593
4.40	1750.	1.78	8.15		0.19	0.16	9.98	0.04	0.10	0.00	1.53	7.95		0.206	1.80	0.610
4.60	1330.	1.82	9.28		0.19	0.16	9.98	0.04	0.10	0.00	1.61	9.08		0.226	1.80	0.626
4.80	2060.	2.41	10.40		0.19	0.16	9.98	0.04	0.10	0.00	2.18	10.14		0.245	1.90	0.642
5.00	1920.	1.98	8.54		0.19	0.16	9.98	0.04	0.10	0.00	1.82	8.34		0.265	1.80	0.659
5.20	2450.	2.19	10.90		0.19	0.16	9.98	0.04	0.10	0.00	1.92	10.64		0.285	1.90	0.676
5.40	2210.	2.26	11.55		0.19	0.16	9.98	0.04	0.10	0.00	1.97	11.29		0.304	1.90	0.693
5.60	2350.	1.87	11.00		0.19	0.16	9.98	0.04	0.10	0.00	1.58	10.74		0.324	1.80	0.710
5.80	2350.	2.50	11.10		0.19	0.16	9.98	0.04	0.10	0.00	2.24	10.84		0.343	1.90	0.727
6.00	2040.	2.28	11.85		0.19	0.16	9.98	0.04	0.10	0.00	1.97	11.59		0.363	1.90	0.745
6.20	1750.	2.11	9.77		0.19	0.16	9.98	0.04	0.10	0.00	1.89	9.57		0.383	1.90	0.761
6.40	1230.	1.86	7.02		0.19	0.16	9.98	0.04	0.10	0.00	1.77	6.82		0.402	1.90	0.777
6.60	1250.	1.99	4.41		0.19	0.16	9.98	0.04	0.10	0.00	2.04	4.21		0.422	1.70	0.792

END OF SOUNDING (INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-1
PAGE 2
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 2.30 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.04 BARS
HI GAGE 0 = 0.10 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.13 BARS
DELTA-B = 0.16 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
K0 FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.20	149.13	4.47	0.00	809.									4093.	SAND
0.40	139.09	2.11	0.00	771.									3847.	SILTY SAND
0.60	71.64	1.70	0.00	490.	8.45		134.9	46.1	0.20	42.6	50.73	437.5	2140.	SANDY SILT
0.80	33.14	2.14	0.00	380.	3.94		76.3	44.1	0.26	40.8	16.43	106.2	1382.	SILTY SAND
1.00	20.37	1.61	0.00	218.	2.50		48.0	42.0	0.32	38.8	8.54	44.5	691.	SANDY SILT
1.20	18.92	1.17	0.00	174.	2.69						7.57	33.3	541.	SILT
1.40	24.46	1.20	0.00	268.	3.11						13.13	49.7	898.	SILT
1.60	20.63	1.11	0.00	241.	2.83						11.52	38.1	768.	SILT
1.80	18.23	1.21	0.00	261.	2.44		26.7	35.4	0.54	32.5	15.55	45.7	802.	SANDY SILT
2.00	17.44	1.06	0.00	242.	2.57						11.11	29.3	733.	SILT
2.20	11.27	0.37	0.00	60.	1.98	0.79					6.17	14.8	158.	SILTY CLAY
2.40	6.05	1.34	0.00	124.	0.92		33.3	37.7	0.71	35.5	2.42	5.5	249.	SANDY SILT
2.60	6.54	2.36	0.00	245.	0.86		62.5	41.4	0.76	39.4	2.38	5.2	518.	SILTY SAND
2.80	5.08	3.07	0.00	258.	0.62		76.7	42.9	0.80	41.2	1.35	2.8	493.	SILTY SAND
3.00	7.16	2.56	0.00	314.	0.90		81.0	42.3	0.83	40.5	2.86	5.8	690.	SILTY SAND
3.20	5.37	2.64	0.00	252.	0.70		72.2	42.0	0.85	40.2	1.77	3.5	490.	SILTY SAND
3.40	3.41	3.30	0.00	206.	0.48		60.5	41.4	0.88	39.7	0.86	1.6	323.	SAND
3.60	3.11	3.63	0.00	213.	0.46		58.4	41.1	0.90	39.4	0.79	1.4	317.	SAND
3.80	2.86	4.10	0.00	228.	0.35		78.3	43.0	0.94	41.5	0.51	0.9	322.	SAND
4.00	4.32	3.96	0.00	341.	0.48		102.2	43.9	0.97	42.4	1.03	1.8	604.	SAND
4.20	3.69	3.56	0.00	271.	0.51		70.9	41.5	0.99	40.0	1.09	1.8	443.	SAND
4.40	2.33	4.44	0.00	219.	0.37		62.0	41.1	1.01	39.5	0.56	0.9	271.	SAND
4.60	2.22	5.38	0.00	259.	0.27		84.3	43.1	1.05	41.7	0.34	0.6	309.	SAND
4.80	3.01	4.11	0.00	276.	0.44		71.3	41.3	1.07	39.9	0.86	1.3	403.	SAND
5.00	2.36	4.19	0.00	226.	0.37		68.0	41.1	1.09	39.8	0.61	0.9	282.	SAND
5.20	2.43	5.31	0.00	302.	0.31		87.8	42.7	1.13	41.4	0.49	0.7	384.	SAND
5.40	2.40	5.61	0.00	324.	0.35		78.6	41.8	1.16	40.5	0.59	0.9	407.	SAND
5.60	1.77	7.27	0.00	318.	0.24		86.1	42.6	1.19	41.4	0.30	0.4	317.	SAND
5.80	2.61	4.53	0.00	298.	0.38		82.9	41.7	1.21	40.5	0.72	1.0	398.	SAND
6.00	2.16	5.98	0.00	334.	0.36		72.6	40.8	1.23	39.6	0.63	0.8	390.	SAND
6.20	1.99	5.08	0.00	266.	0.37		62.2	39.7	1.25	38.4	0.67	0.9	292.	SAND
6.40	1.76	3.69	0.00	175.	0.42		43.2	37.1	1.25	35.7	0.78	1.0	174.	SAND
6.60	2.04	1.35	0.00	75.	0.46		43.0	36.8	1.27	35.5	0.96	1.2	71.	SANDY SILT

END OF SOUNDING

PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

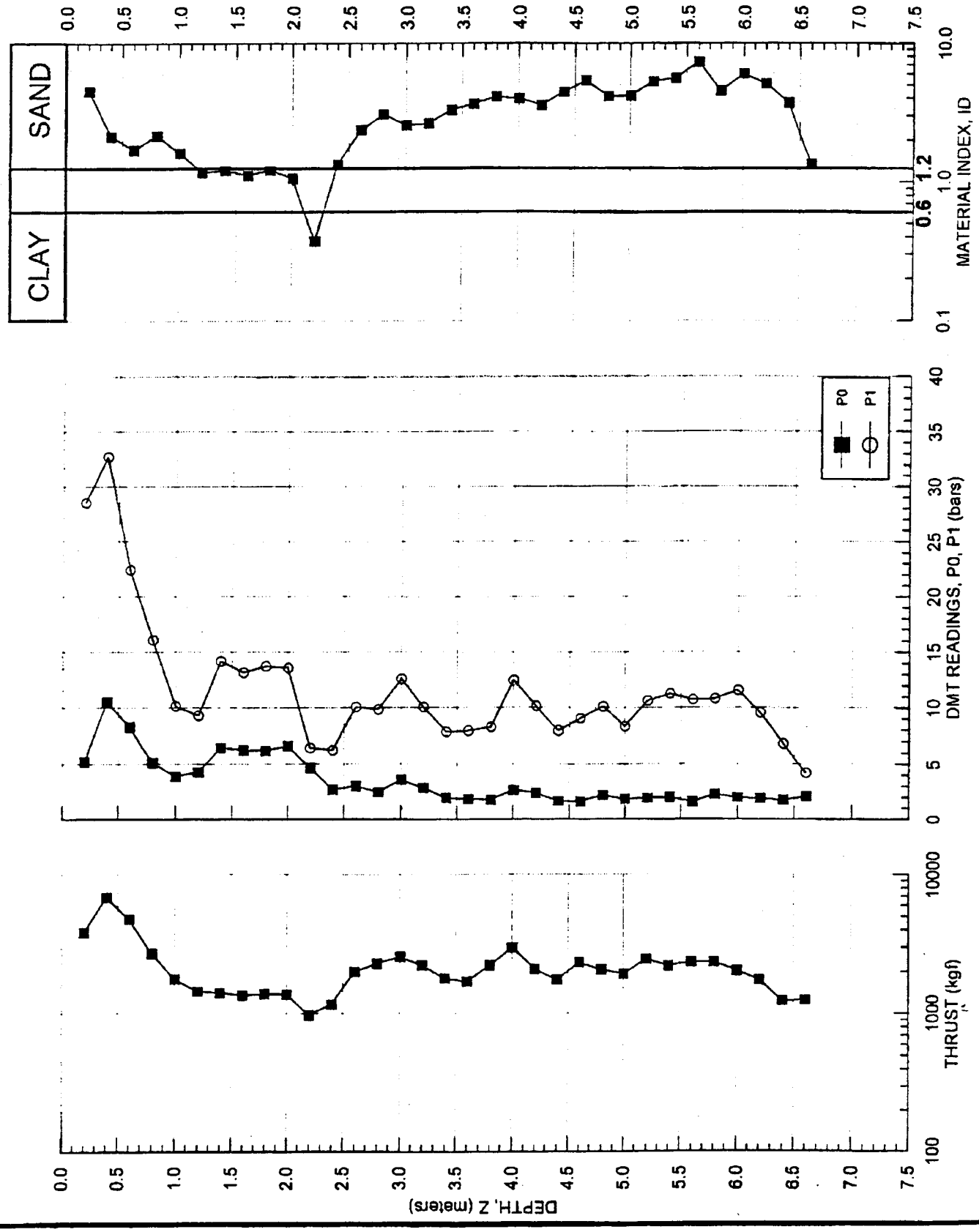
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 7-2-97

SOUNDING

270DP-1

DILATOMETER RESULTS

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.3 m



PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

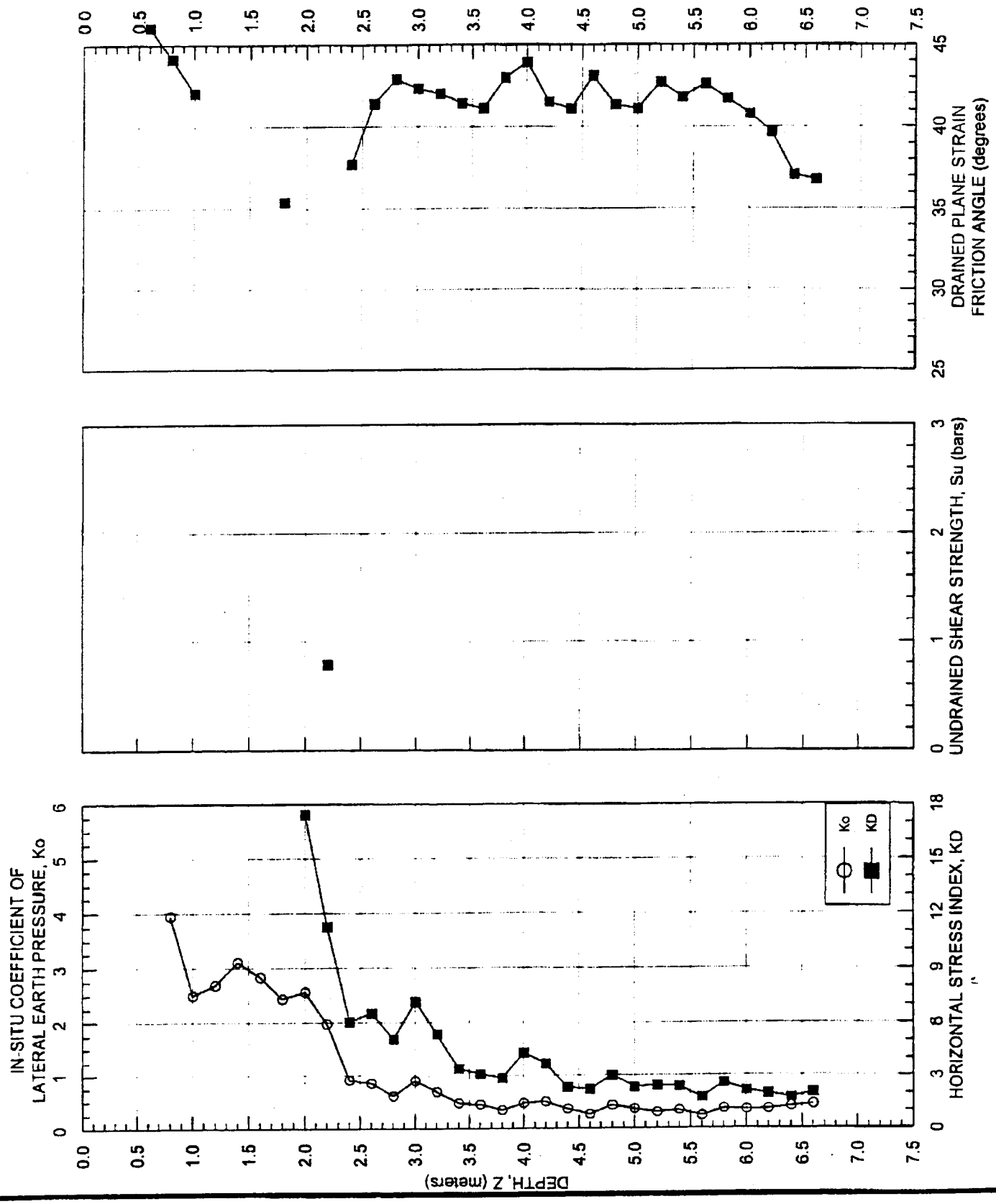
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

INTERPRETED DMT STRENGTH PARAMETERS

270DP-1

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.3 m



PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

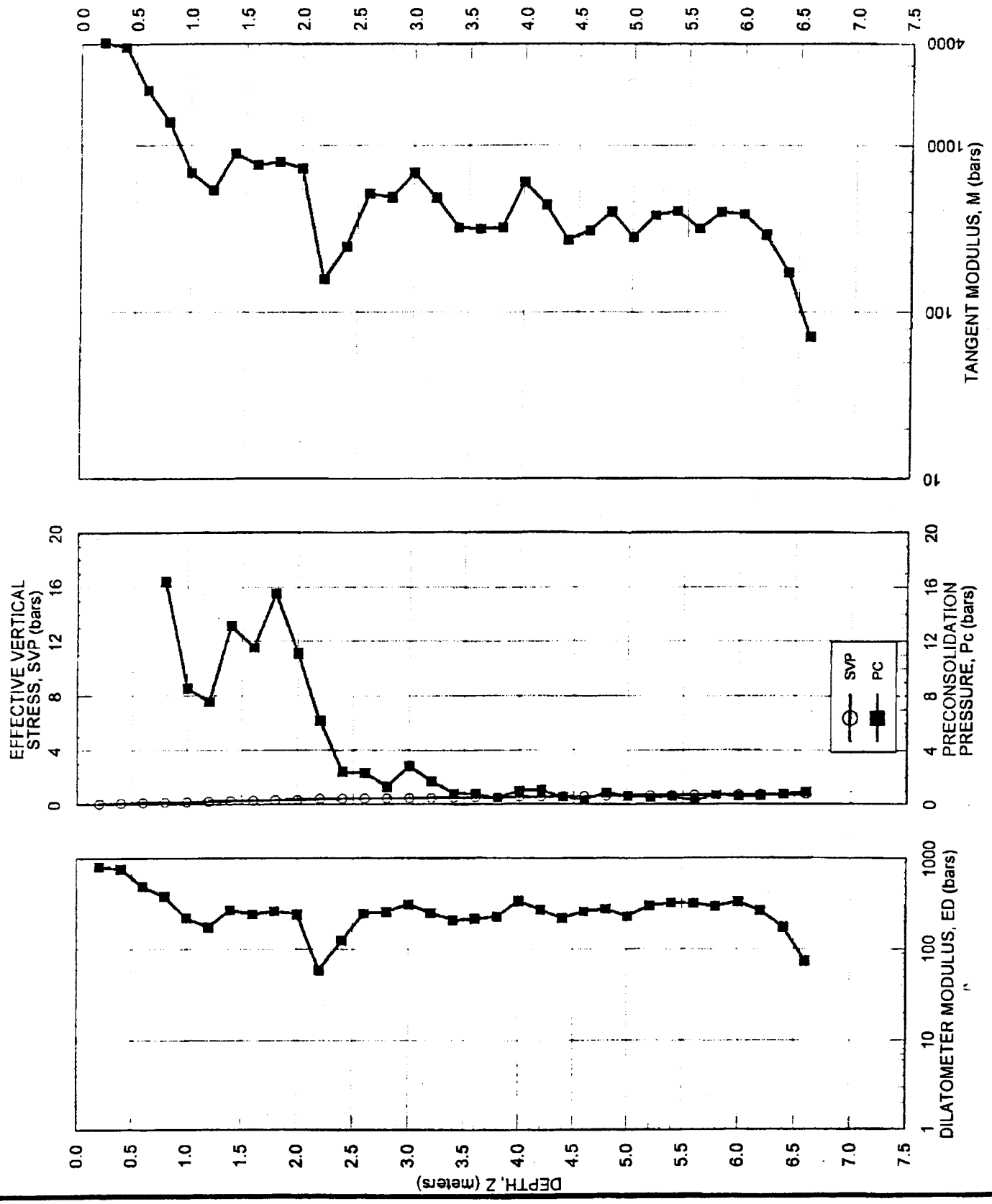
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

270DP-1

INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.3 m



DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT BUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-2
PAGE 1
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 1.40 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.03 BARS
HI GAGE 0 = 0.05 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.15 BARS
DELTA-B = 0.20 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
KO FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.20	5000.	8.52	33.25		0.15	0.20	9.98	0.03	0.05	0.00	7.42	33.00		0.000	2.15	0.035
0.40	5300.	10.75	28.20		0.15	0.20	9.98	0.03	0.05	0.00	9.99	27.95		0.000	2.10	0.077
0.60	3100.	4.58	11.60		0.15	0.20	9.98	0.03	0.05	0.00	4.37	11.35		0.000	1.80	0.115
0.80	1600.	2.55	6.13		0.15	0.20	9.98	0.03	0.05	0.00	2.51	5.90		0.000	1.70	0.149
1.00	910.	1.72	3.68		0.15	0.20	9.98	0.03	0.05	0.00	1.76	3.45		0.000	1.70	0.183
1.20	1750.	1.32	3.25		0.15	0.20	9.98	0.03	0.05	0.00	1.36	3.02		0.000	1.60	0.215
1.60	850.	4.11	10.25		0.15	0.20	9.98	0.03	0.05	0.00	3.94	10.00		0.020	1.80	0.262
1.80	1160.	5.72	12.30		0.15	0.20	9.98	0.03	0.05	0.00	5.53	12.05		0.039	1.95	0.279
2.00	1250.	6.04	12.10		0.15	0.20	9.98	0.03	0.05	0.00	5.88	11.85		0.059	1.95	0.298
2.20	1030.	5.07	8.96		0.15	0.20	9.98	0.03	0.05	0.00	5.01	8.73		0.079	1.80	0.315
2.40	820.	4.39	6.77		0.15	0.20	9.98	0.03	0.05	0.00	4.41	6.54		0.098	1.80	0.331
2.60	1260.	2.10	5.87		0.15	0.20	9.98	0.03	0.05	0.00	2.05	5.64		0.118	1.80	0.347
2.80	1420.	1.91	7.83		0.15	0.20	9.98	0.03	0.05	0.00	1.75	7.60		0.137	1.80	0.362
3.00	1340.	2.24	7.92		0.15	0.20	9.98	0.03	0.05	0.00	2.09	7.69		0.157	1.80	0.378
3.20	2960.	2.57	11.45		0.15	0.20	9.98	0.03	0.05	0.00	2.26	11.20		0.177	1.90	0.395
3.40	3240.	4.88	16.35		0.15	0.20	9.98	0.03	0.05	0.00	4.44	16.10		0.196	2.00	0.413
3.60	2920.	4.05	13.70		0.15	0.20	9.98	0.03	0.05	0.00	3.71	13.45		0.216	1.90	0.432
3.80	2050.	2.72	9.93		0.15	0.20	9.98	0.03	0.05	0.00	2.50	9.70		0.236	1.90	0.450
4.00	2210.	2.97	11.25		0.15	0.20	9.98	0.03	0.05	0.00	2.69	11.00		0.255	1.90	0.467
4.20	2420.	2.75	10.25		0.15	0.20	9.98	0.03	0.05	0.00	2.51	10.00		0.275	1.90	0.485
4.40	2310.	2.61	10.40		0.15	0.20	9.98	0.03	0.05	0.00	2.36	10.15		0.294	1.90	0.503
4.60	2060.	2.20	8.91		0.15	0.20	9.98	0.03	0.05	0.00	2.00	8.68		0.314	1.80	0.519
4.80	1920.	2.39	9.79		0.15	0.20	9.98	0.03	0.05	0.00	2.16	9.56		0.334	1.90	0.536
5.00	1800.	1.93	8.68		0.15	0.20	9.98	0.03	0.05	0.00	1.73	8.45		0.353	1.80	0.553
5.20	2150.	2.06	9.49		0.15	0.20	9.98	0.03	0.05	0.00	1.83	9.26		0.373	1.80	0.568
5.40	3490.	2.95	14.10		0.15	0.20	9.98	0.03	0.05	0.00	2.53	13.85		0.393	1.90	0.585
5.60	3900.	3.45	13.95		0.15	0.20	9.98	0.03	0.05	0.00	3.06	13.70		0.412	1.90	0.603
5.80	3240.	3.14	11.55		0.15	0.20	9.98	0.03	0.05	0.00	2.86	11.30		0.432	1.90	0.620
6.00	3960.	2.88	13.75		0.15	0.20	9.98	0.03	0.05	0.00	2.47	13.50		0.451	1.90	0.638
6.20	3760.	2.78	13.25		0.15	0.20	9.98	0.03	0.05	0.00	2.39	13.00		0.471	1.90	0.656
6.40	1960.	2.21	8.76		0.15	0.20	9.98	0.03	0.05	0.00	2.02	8.53		0.491	1.80	0.672
6.60	1820.	2.03	5.88		0.15	0.20	9.98	0.03	0.05	0.00	1.97	5.65		0.510	1.80	0.688

END OF SOUNDING

(INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-2
PAGE 2
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 1.40 M
SP.GR WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.03 BARS
HI GAGE 0 = 0.05 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.15 BARS
DELTA-B = 0.20 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
K0 FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 - 1.044 TSF - 14.51 PSI 1 M = 3.2808 FT

Z (M)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.20	212.06	3.45	0.00	888.									4785.	SAND
0.40	130.30	1.80	0.00	623.									3072.	SANDY SILT
0.60	37.98	1.60	0.00	242.	4.29		94.1	47.3	0.20	44.0	13.74	119.6	913.	SANDY SILT
0.80	16.80	1.35	0.00	118.	1.96		48.4	44.4	0.25	41.1	4.08	27.3	352.	SANDY SILT
1.00	9.63	0.96	0.00	59.	1.80						2.12	11.6	144.	SILT
1.20	6.33	1.22	0.00	58.	0.55		60.5	46.4	0.37	43.8	0.55	2.6	118.	SANDY SILT
1.40	14.96	1.54	0.00	210.	2.07		16.7	34.7	0.41	31.2	8.31	31.7	606.	SANDY SILT
1.60	19.65	1.19	0.00	226.	2.75						9.87	35.3	710.	SILT
1.80	19.52	1.03	0.00	207.	2.74						10.42	35.0	650.	SILT
2.00	15.66	0.75	0.00	129.	2.41						7.81	24.8	377.	CLAYEY SILT
2.20	13.03	0.49	0.00	74.	2.16	0.76					6.15	18.6	203.	SILTY CLAY
2.40	5.57	1.86	0.00	125.	0.77		39.9	40.6	0.57	38.2	1.42	4.1	243.	SILTY SAND
2.60	4.46	3.62	0.00	203.	0.59		47.6	41.9	0.60	39.6	0.90	2.5	365.	SAND
2.80	5.12	2.89	0.00	194.	0.72		43.1	40.7	0.62	38.4	1.33	3.5	372.	SILTY SAND
3.00	5.29	4.28	0.00	310.	0.46		103.6	46.0	0.68	44.2	0.71	1.8	604.	SAND
3.20	10.28	2.74	0.00	404.	1.21		103.1	43.7	0.70	41.8	4.40	10.7	1022.	SILTY SAND
3.40	8.08	2.79	0.00	338.	0.95		95.0	43.7	0.73	41.8	2.85	6.6	782.	SILTY SAND
3.60	5.03	3.19	0.00	250.	0.63		68.5	42.6	0.75	40.7	1.30	2.9	476.	SILTY SAND
3.80	5.22	3.40	0.00	288.	0.65		73.8	42.7	0.78	40.9	1.43	3.1	558.	SAND
4.00	4.62	3.34	0.00	260.	0.54		82.8	43.5	0.82	41.7	1.06	2.2	475.	SAND
4.20	4.11	3.77	0.00	270.	0.49		79.6	43.2	0.85	41.5	0.91	1.8	467.	SAND
4.40	3.25	3.96	0.00	232.	0.41		72.2	42.7	0.87	41.1	0.64	1.2	353.	SAND
4.60	3.40	4.06	0.00	257.	0.46		66.3	41.9	0.89	40.2	0.82	1.5	402.	SAND
4.80	2.49	4.88	0.00	233.	0.36		64.1	41.9	0.92	40.3	0.49	0.9	301.	SAND
5.00	2.56	5.12	0.00	258.	0.32		77.1	42.9	0.96	41.4	0.43	0.8	339.	SAND
5.20	3.66	5.29	0.00	393.	0.42		94.1	43.5	0.99	42.1	0.79	1.4	639.	SAND
5.40	4.40	4.01	0.00	369.	0.52		99.5	43.3	1.02	41.9	1.22	2.0	659.	SAND
5.60	3.91	3.48	0.00	293.	0.54		75.8	41.6	1.03	40.1	1.26	2.0	493.	SAND
5.80	3.17	5.45	0.00	383.	0.34		105.2	43.9	1.08	42.6	0.58	0.9	575.	SAND
6.00	2.93	5.51	0.00	368.	0.34		98.2	43.4	1.11	42.1	0.58	0.9	528.	SAND
6.20	2.27	4.26	0.00	226.	0.35		69.9	41.2	1.12	39.9	0.58	0.9	274.	SAND
6.40	2.13	2.51	0.00	128.	0.36		65.0	40.6	1.14	39.3	0.59	0.9	141.	SILTY SAND

END OF SOUNDING

PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

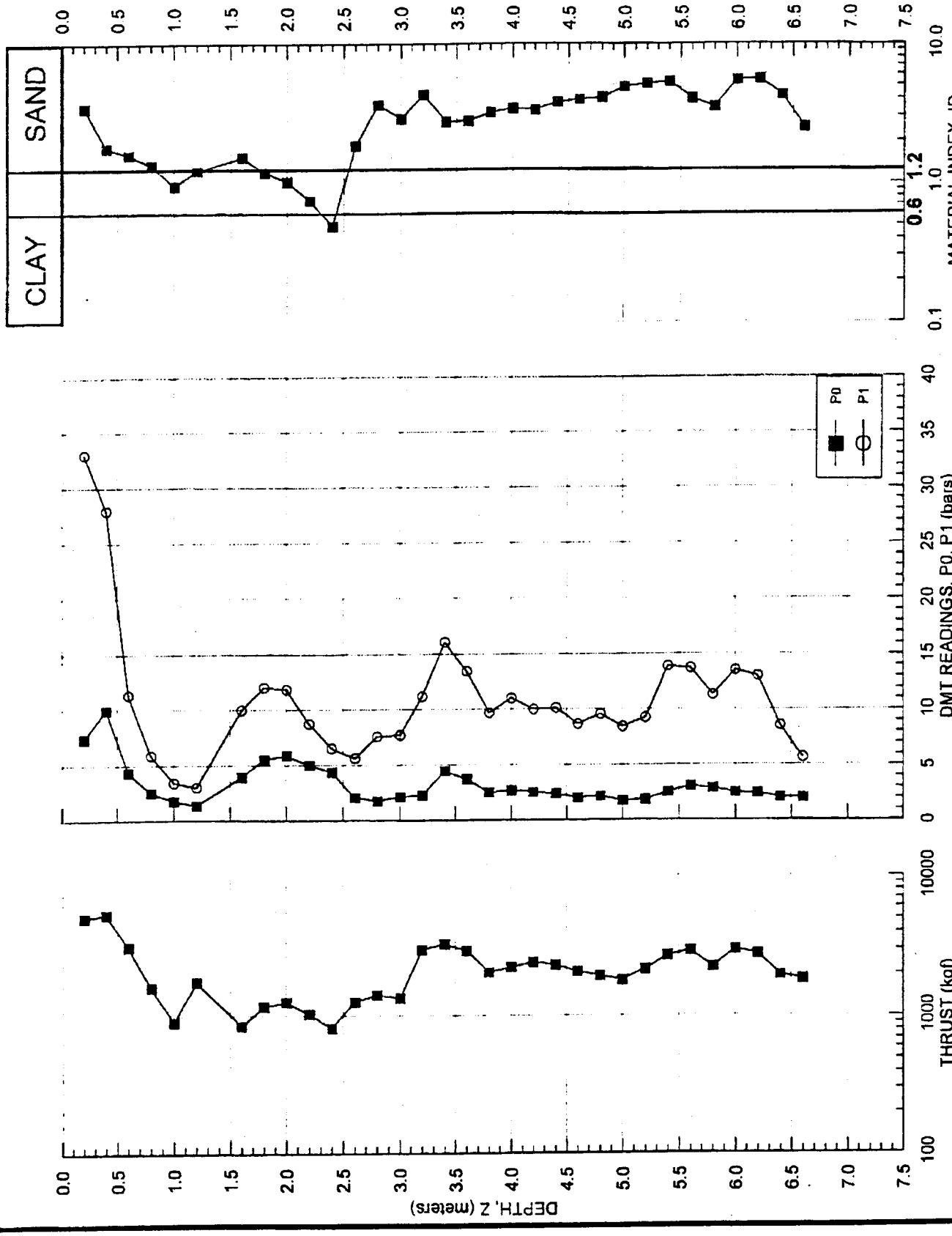
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 7-2-97

SOUNDING

270DP-2

DILATOMETER RESULTS

Ground Surface Elev.: ~5.0 m
Water Depth: ~1.4 m



Note: Gravel at 1.4 meters

PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

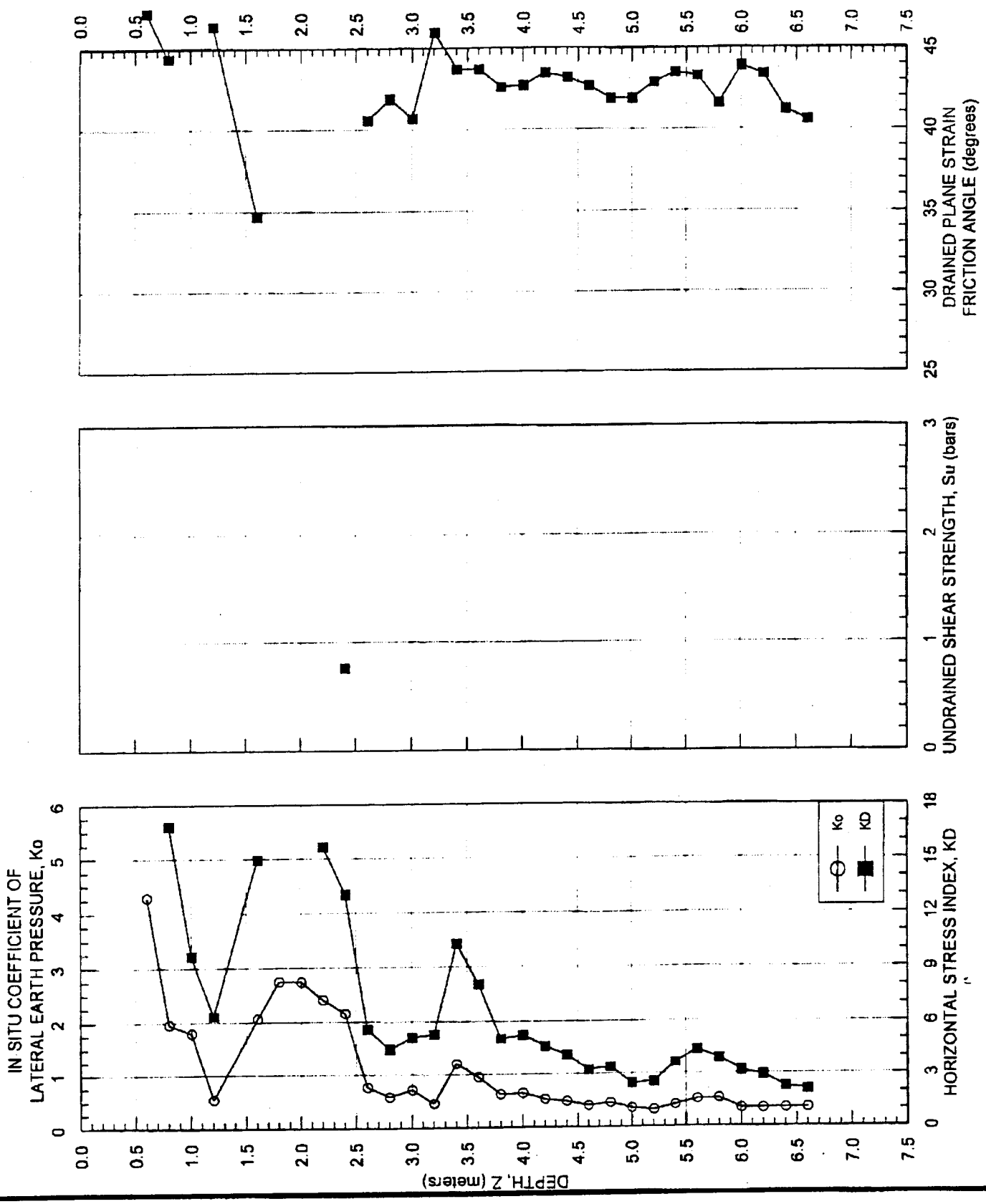
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

INTERPRETED DMT STRENGTH PARAMETERS

270DP-2

Ground Surface Elev.: ~5.0 m
Water Depth: ~1.4 m



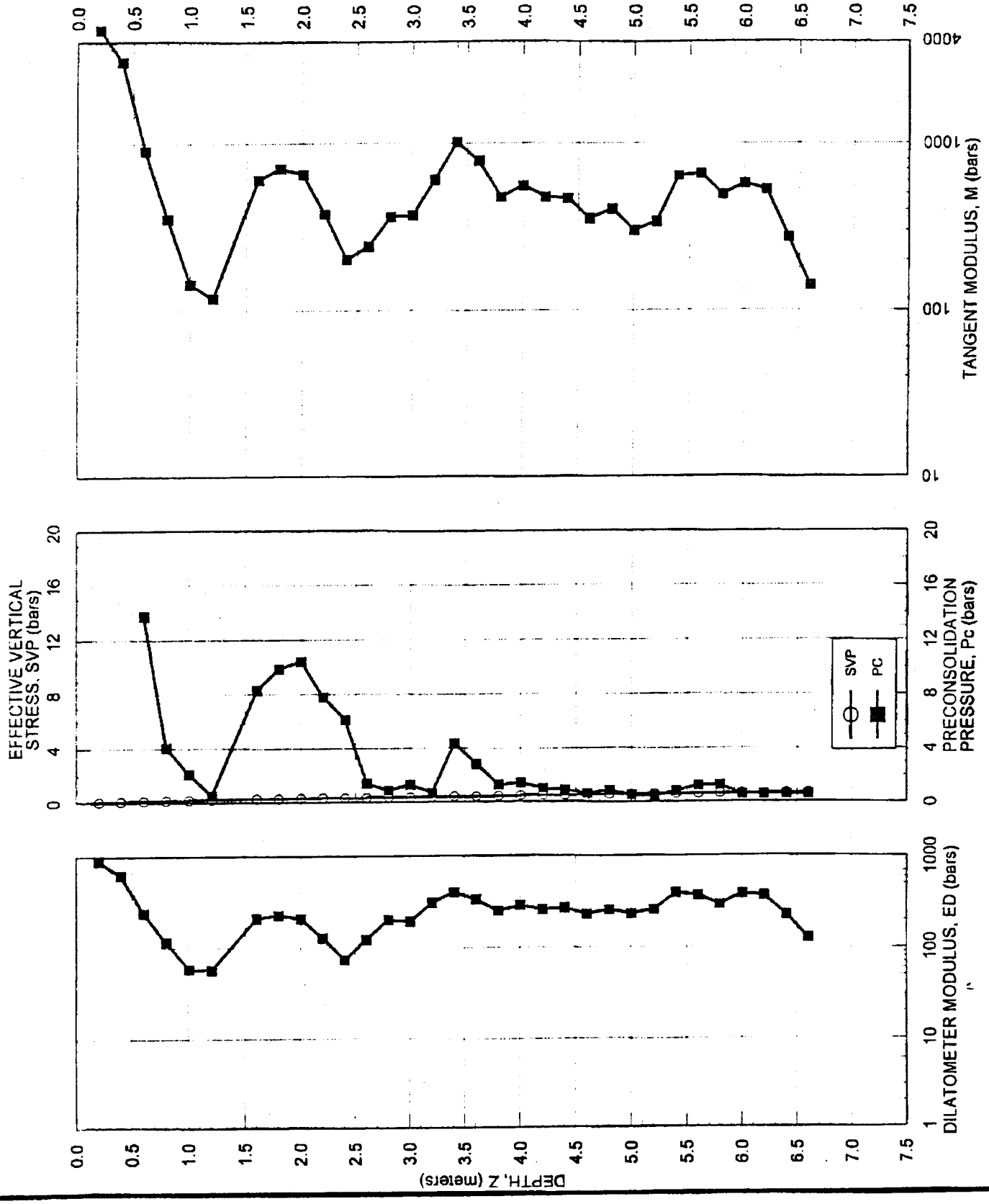
PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING
270DP-2

INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~5.0 m
Water Depth: ~1.4 m



DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-3
PAGE 1
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 2.00 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.01 BARS
HI GAGE 0 = 0.00 BARS
CAL. GAGE 0 = 0.00 BARS
SU OPTION - MARCHETTI

ROD DIAM. = 3.57 CM
FR.ROD.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.19 BARS
DELTA-B = 0.16 BARS
OCR OPTION- MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
KO FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.20	3400.	6.52	28.65		0.19	0.16	9.98	0.01	0.00	0.00	5.61	28.49		0.000	2.00	0.035
0.40	5830.	9.29	33.50		0.19	0.16	9.98	0.01	0.00	0.00	8.28	33.34		0.000	2.15	0.076
0.60	5560.	8.63	29.25		0.19	0.16	9.98	0.01	0.00	0.00	7.80	29.09		0.000	2.15	0.118
0.80	3310.	4.48	15.45		0.19	0.16	9.98	0.01	0.00	0.00	4.13	15.29		0.000	2.00	0.159
1.00	1900.	4.00	11.05		0.19	0.16	9.98	0.01	0.00	0.00	3.84	10.89		0.000	1.90	0.197
1.20	1380.	5.72	10.50		0.19	0.16	9.98	0.01	0.00	0.00	5.68	10.34		0.000	1.80	0.233
1.40	1430.	8.89	17.45		0.19	0.16	9.98	0.01	0.00	0.00	8.66	17.29		0.000	1.95	0.270
1.60	1530.	9.58	17.55		0.19	0.16	9.98	0.01	0.00	0.00	9.38	17.39		0.000	1.95	0.308
1.80	1420.	8.38	15.75		0.19	0.16	9.98	0.01	0.00	0.00	8.21	15.59		0.000	1.95	0.347
2.00	1050.	6.32	10.50		0.19	0.16	9.98	0.01	0.00	0.00	6.31	10.34		0.000	1.80	0.383
2.20	750.	5.50	7.38		0.19	0.16	9.98	0.01	0.00	0.00	5.60	7.21		0.020	1.80	0.399
2.40	1840.	3.31	11.35		0.19	0.16	9.98	0.01	0.00	0.00	3.10	11.19		0.039	1.90	0.416
2.60	1850.	2.38	8.24		0.19	0.16	9.98	0.01	0.00	0.00	2.28	8.07		0.059	1.90	0.433
2.80	2420.	2.66	10.00		0.19	0.16	9.98	0.01	0.00	0.00	2.49	9.84		0.079	1.90	0.451
3.00	2440.	3.11	11.55		0.19	0.16	9.98	0.01	0.00	0.00	2.88	11.39		0.098	1.90	0.469
3.20	1830.	2.22	9.07		0.19	0.16	9.98	0.01	0.00	0.00	2.07	8.90		0.118	1.90	0.486
3.40	2010.	2.21	9.42		0.19	0.16	9.98	0.01	0.00	0.00	2.05	9.25		0.137	1.90	0.504
3.60	2950.	3.40	12.80		0.19	0.16	9.98	0.01	0.00	0.00	3.13	12.64		0.157	1.90	0.522
3.80	2290.	3.29	11.85		0.19	0.16	9.98	0.01	0.00	0.00	3.06	11.69		0.177	1.90	0.539
4.00	1880.	2.38	9.32		0.19	0.16	9.98	0.01	0.00	0.00	2.23	9.15		0.196	1.90	0.557
4.20	1540.	1.83	7.77		0.19	0.16	9.98	0.01	0.00	0.00	1.73	7.60		0.216	1.80	0.574
4.40	1460.	2.06	8.36		0.19	0.16	9.98	0.01	0.00	0.00	1.94	8.19		0.236	1.80	0.589
4.60	1110.	1.57	6.05		0.19	0.16	9.98	0.01	0.00	0.00	1.54	5.88		0.255	1.80	0.605
4.80	1080.	1.32	5.63		0.19	0.16	9.98	0.01	0.00	0.00	1.30	5.46		0.275	1.80	0.621
5.00	1160.	1.36	5.86		0.19	0.16	9.98	0.01	0.00	0.00	1.33	5.69		0.294	1.80	0.637
5.20	1210.	1.36	5.89		0.19	0.16	9.98	0.01	0.00	0.00	1.33	5.72		0.314	1.80	0.652
5.40	1720.	1.54	7.60		0.19	0.16	9.98	0.01	0.00	0.00	1.43	7.43		0.334	1.80	0.668
5.60	2870.	2.35	10.90		0.19	0.16	9.98	0.01	0.00	0.00	2.12	10.74		0.353	1.90	0.685
5.80	2410.	2.96	12.15		0.19	0.16	9.98	0.01	0.00	0.00	2.70	11.99		0.373	1.90	0.702
6.00	1940.	2.54	11.53		0.19	0.16	9.98	0.01	0.00	0.00	2.29	11.39		0.393	1.90	0.720
6.20	1540.	2.16	9.46		0.19	0.16	9.98	0.01	0.00	0.00	1.99	9.29		0.412	1.80	0.737
6.40	1240.	1.93	7.41		0.19	0.16	9.98	0.01	0.00	0.00	1.85	7.24		0.432	1.80	0.752
6.60	2000.	1.58	7.53		0.19	0.16	9.98	0.01	0.00	0.00	1.48	7.36		0.451	1.80	0.768

END OF SOUNDING

(INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 27CDP-3
PAGE 2
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF ELEV. = 5.00 M
WATER DEPTH = 2.00 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.96 BARS
LO GAGE 0 = 0.01 BARS
HI GAGE 0 = 0.00 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION - MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.19 BARS
DELTA-B = 0.16 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
K0 FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.20	160.30	4.08	0.00	794.									4070.	SAND
0.40	109.30	3.03	0.00	870.									4143.	SILTY SAND
0.60	66.11	2.73	0.00	739.	7.62		167.8	47.9	0.21	44.7	40.33	342.0	3169.	SILTY SAND
0.80	26.02	2.70	0.00	387.	2.89		104.1	46.8	0.27	43.9	9.12	57.5	1319.	SILTY SAND
1.00	19.52	1.83	0.00	244.	2.37		53.4	42.6	0.33	39.5	7.87	39.9	766.	SILTY SAND
1.20	24.34	0.82	0.00	162.	3.11						11.51	49.3	541.	CLAYEY SILT
1.40	32.07	1.00	0.00	299.	3.62						20.48	75.8	1079.	SILT
1.60	30.42	0.85	0.00	278.	3.51						21.53	69.8	988.	CLAYEY SILT
1.80	23.68	0.90	0.00	256.	3.06						16.38	47.3	849.	CLAYEY SILT
2.00	16.45	0.64	0.00	140.	2.48						10.27	26.8	416.	CLAYEY SILT
2.20	13.99	0.29	0.00	56.	2.26	1.00					8.30	20.8	157.	CLAY
2.40	7.37	2.64	0.00	281.	0.97		56.4	41.1	0.69	39.0	2.75	6.6	625.	SILTY SAND
2.60	6.13	2.60	0.00	201.	0.67		60.9	42.1	0.72	40.1	1.37	3.2	382.	SILTY SAND
2.80	5.35	3.05	0.00	255.	0.62		81.5	43.6	0.76	41.8	1.31	2.9	499.	SILTY SAND
3.00	5.95	3.05	0.00	295.	0.72		80.5	43.0	0.79	41.2	1.79	3.8	605.	SILTY SAND
3.20	4.02	3.49	0.00	237.	0.54		61.8	41.8	0.81	40.0	1.01	2.1	405.	SAND
3.40	3.79	3.77	0.00	250.	0.46		76.5	43.1	0.85	41.4	0.79	1.6	414.	SAND
3.60	5.69	3.20	0.00	330.	0.66		99.1	43.7	0.88	42.1	1.70	3.2	664.	SILTY SAND
3.80	5.34	2.99	0.00	299.	0.70		74.8	41.8	0.90	40.2	1.87	3.5	586.	SILTY SAND
4.00	3.65	3.40	0.00	240.	0.52		63.6	41.3	0.92	39.6	1.04	1.9	390.	SAND
4.20	2.64	3.88	0.00	204.	0.43		53.4	40.3	0.95	38.7	0.70	1.2	274.	SAND
4.40	2.30	3.66	0.00	217.	0.49		49.6	39.5	0.96	37.9	0.90	1.5	309.	SAND
4.60	2.13	3.37	0.00	150.	0.44		38.4	37.9	0.98	36.1	0.71	1.2	174.	SAND
4.80	1.65	4.05	0.00	144.	0.39		38.6	37.9	1.00	36.2	0.54	0.9	135.	SAND
5.00	1.63	4.20	0.00	151.	0.37		41.6	38.3	1.03	36.7	0.52	0.8	140.	SAND
5.20	1.56	4.32	0.00	152.	0.36		43.7	38.5	1.06	36.9	0.50	0.8	135.	SAND
5.40	1.65	5.45	0.00	208.	0.29		62.7	40.8	1.10	39.5	0.38	0.6	194.	SAND
5.60	2.58	4.88	0.00	299.	0.29		103.2	43.7	1.16	42.4	0.43	0.6	396.	SAND
5.80	3.31	4.00	0.00	322.	0.46		82.9	41.6	1.17	40.3	1.06	1.5	496.	SAND
6.00	2.63	4.81	0.00	316.	0.43		67.4	40.3	1.19	39.0	0.88	1.2	423.	SAND
6.20	2.15	4.62	0.00	253.	0.42		53.8	38.8	1.20	37.5	0.79	1.1	294.	SAND
6.40	1.89	3.79	0.00	187.	0.45		39.6	36.6	1.20	35.2	0.85	1.1	197.	SAND
6.60	1.34	5.72	0.00	204.	0.22		81.8	41.9	1.28	40.8	0.25	0.3	173.	SAND

END OF SOUNDING

PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

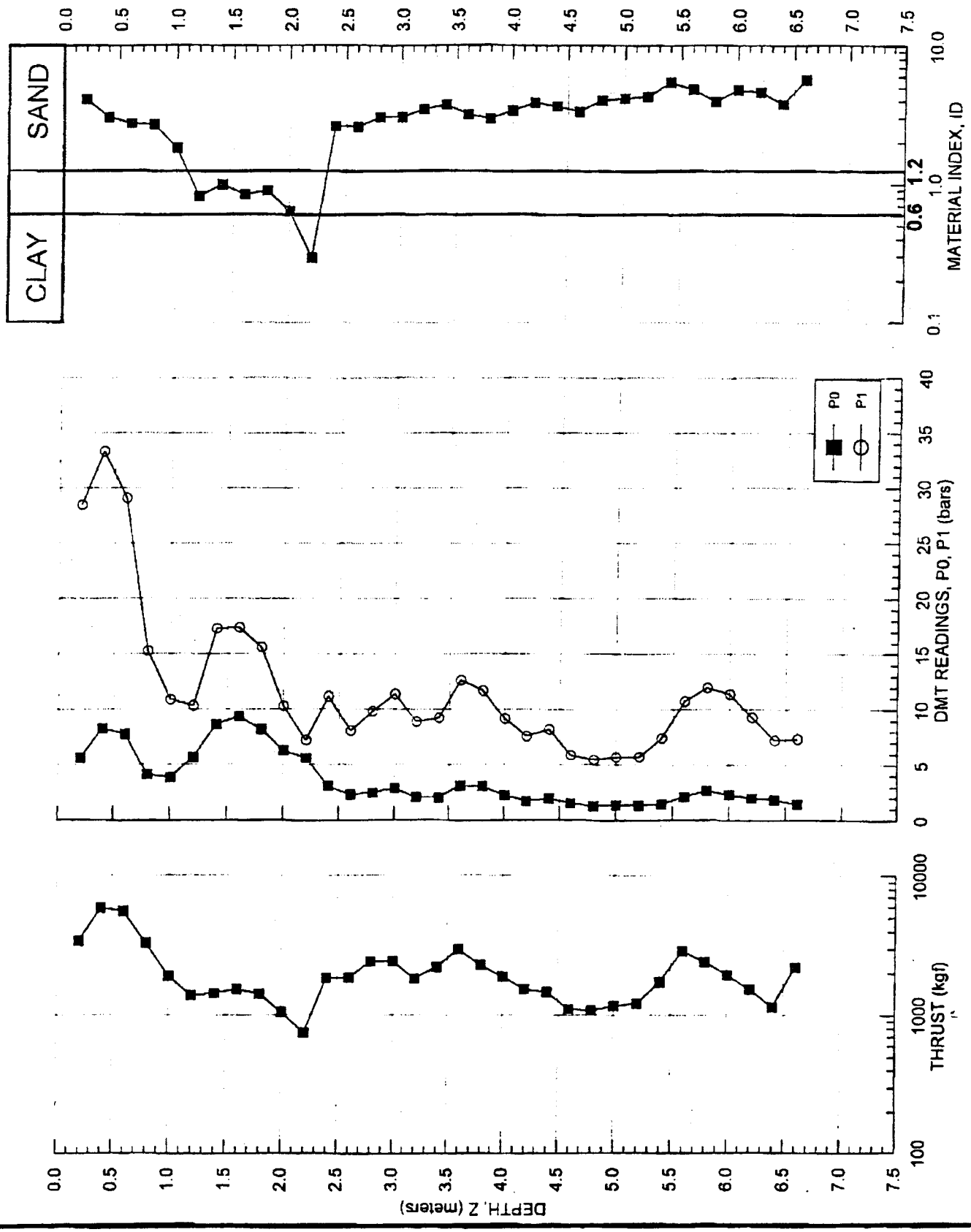
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 7-2-97

SOUNDING

270DP-3

DILATOMETER RESULTS

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.0 m



PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

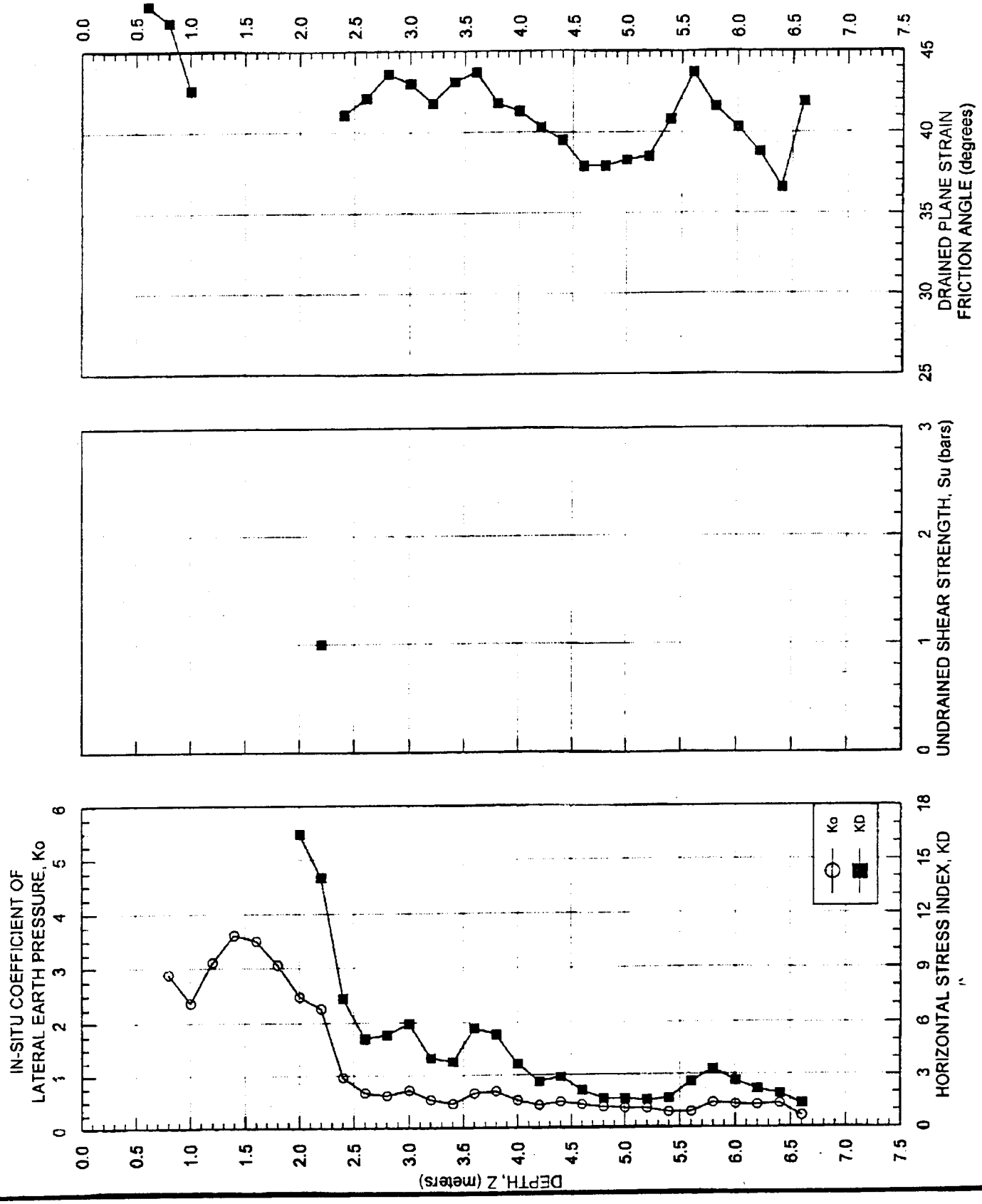
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

INTERPRETED DMT STRENGTH PARAMETERS

270DP-3

Ground Surface Elev.: ~6.0 m
Water Depth: ~2.0 m



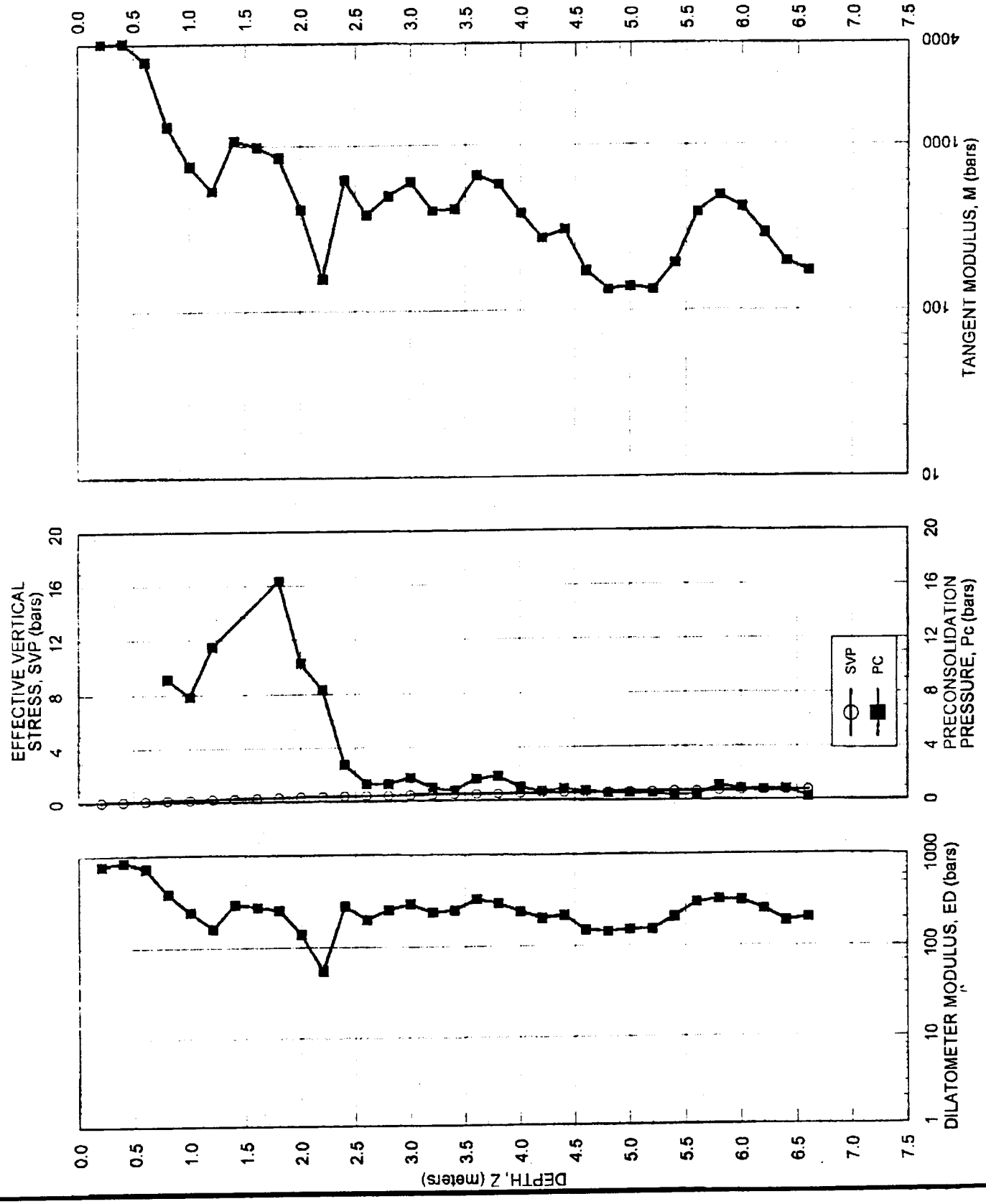
PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING
270DP-3

INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.0 m



DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE. AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-4
PAGE 1
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 1.90 M
SP GR WATER = 1.000
MAX SU ID = 3.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.04 BARS
HI GAGE 0 = 0.00 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.19 BARS
DELTA-B = 0.10 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
KO FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.40	3900.	9.70	25.55		0.19	0.10	9.98	0.04	0.00	0.00	9.07	25.45		0.000	2.15	0.070
0.60	2980.	8.82	20.40		0.19	0.10	9.98	0.04	0.00	0.00	8.40	20.30		0.000	1.95	0.110
0.80	2875.	8.46	21.15		0.19	0.10	9.98	0.04	0.00	0.00	7.99	21.05		0.000	1.95	0.149
1.00	2450.	10.55	21.60		0.16	0.25	9.98	0.04	0.00	0.00	10.18	21.35		0.000	1.95	0.187
1.20	1860.	11.40	19.45		0.16	0.25	9.98	0.04	0.00	0.00	11.18	19.20		0.000	1.95	0.225
1.40	2530.	9.79	20.35		0.16	0.25	9.98	0.04	0.00	0.00	9.40	20.10		0.000	1.95	0.263
1.60	2820.	4.33	16.60		0.16	0.25	9.98	0.04	0.00	0.00	3.85	16.35		0.000	2.00	0.302
1.80	2050.	2.76	10.55		0.16	0.25	9.98	0.04	0.00	0.00	2.51	10.30		0.000	1.90	0.340
2.00	2340.	2.19	10.15		0.16	0.25	9.98	0.04	0.00	0.00	1.93	9.90		0.010	1.90	0.368
2.20	1800.	2.31	9.42		0.16	0.25	9.98	0.04	0.00	0.00	2.09	9.13		0.029	1.90	0.386
2.40	2010.	2.20	9.23		0.16	0.25	9.98	0.04	0.00	0.00	1.99	8.94		0.049	1.90	0.403
2.60	2070.	1.96	9.56		0.16	0.25	9.98	0.04	0.00	0.00	1.72	9.27		0.069	1.80	0.420
2.80	2390.	2.32	12.25		0.16	0.25	9.98	0.04	0.00	0.00	1.96	12.00		0.088	1.90	0.437
3.00	2770.	2.34	13.30		0.16	0.25	9.98	0.04	0.00	0.00	2.56	13.05		0.108	1.90	0.454
3.20	3200.	3.36	15.00		0.16	0.25	9.98	0.04	0.00	0.00	2.92	14.75		0.128	1.90	0.472
3.40	2480.	2.67	11.40		0.16	0.25	9.98	0.04	0.00	0.00	2.37	11.15		0.147	1.90	0.490
3.60	2540.	2.44	11.30		0.16	0.25	9.98	0.04	0.00	0.00	2.14	11.05		0.167	1.90	0.507
3.80	2350.	3.06	12.70		0.16	0.25	9.98	0.04	0.00	0.00	2.72	12.45		0.186	1.90	0.525
4.00	2140.	2.44	10.55		0.16	0.25	9.98	0.04	0.00	0.00	2.17	10.30		0.206	1.90	0.543
4.20	2600.	2.04	10.25		0.16	0.25	9.98	0.04	0.00	0.00	1.77	10.00		0.226	1.80	0.559
4.40	2950.	2.89	12.85		0.16	0.25	9.98	0.04	0.00	0.00	2.53	12.60		0.245	1.90	0.576
4.60	2250.	2.36	10.70		0.16	0.25	9.98	0.04	0.00	0.00	2.08	10.45		0.265	1.90	0.594
4.80	1810.	1.89	9.13		0.16	0.25	9.98	0.04	0.00	0.00	1.67	8.84		0.285	1.80	0.610
5.00	2220.	1.86	10.25		0.16	0.25	9.98	0.04	0.00	0.00	1.58	10.00		0.304	1.80	0.626
5.20	2350.	1.94	10.45		0.16	0.25	9.98	0.04	0.00	0.00	1.65	10.20		0.324	1.80	0.642
5.40	2430.	1.98	10.85		0.16	0.25	9.98	0.04	0.00	0.00	1.67	10.60		0.343	1.80	0.657
5.60	1820.	1.86	11.20		0.16	0.25	9.98	0.04	0.00	0.00	1.53	10.95		0.363	1.80	0.673
5.80	2260.	1.72	11.35		0.16	0.25	9.98	0.04	0.00	0.00	1.38	11.10		0.383	1.80	0.689
6.00	3270.	2.56	13.45		0.16	0.25	9.98	0.04	0.00	0.00	2.15	13.20		0.402	1.90	0.705
6.20	3890.	3.57	15.45		0.16	0.25	9.98	0.04	0.00	0.00	3.11	15.20		0.422	1.90	0.723
6.40	3210.	3.48	15.00		0.16	0.25	9.98	0.04	0.00	0.00	3.04	14.75		0.442	1.90	0.741
6.60	3320.	1.88	8.37		0.16	0.25	9.98	0.04	0.00	0.00	1.70	8.08		0.461	1.80	0.757

END OF SOUNDING

(INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-4
PAGE 2
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 1.90 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.04 BARS
HI GAGE 0 = 0.00 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.19 BARS
DELTA-B = 0.10 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
K0 FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.40	129.57	1.81	0.00	568.									2799.	SILTY SAND
0.60	76.23	1.42	0.00	413.	9.21		70.6	42.4	0.18	38.3	65.53	594.4	1826.	SANDY SILT
0.80	53.79	1.64	0.00	453.	6.53		69.4	41.8	0.25	38.1	45.37	305.5	1855.	SANDY SILT
1.00	54.49	1.10	0.00	388.	4.81						32.39	173.4	1591.	SILT
1.20	49.67	0.72	0.00	278.	4.58						33.77	150.1	1118.	CLAYEY SILT
1.40	35.70	1.14	0.00	371.	3.84						23.61	89.6	1375.	SILT
1.60	12.76	3.24	0.00	434.	1.48		88.3	44.2	0.51	41.9	4.81	15.9	1184.	SILTY SAND
1.80	7.37	3.11	0.00	270.	0.88		66.5	43.4	0.57	41.1	1.92	5.6	604.	SILTY SAND
2.00	5.22	4.15	0.00	277.	0.53		80.6	45.0	0.63	43.0	0.81	2.2	535.	SAND
2.20	5.36	3.41	0.00	244.	0.67		59.6	42.6	0.65	40.5	1.25	3.2	478.	SAND
2.40	4.81	3.58	0.00	241.	0.57		68.2	43.4	0.68	41.4	0.97	2.4	450.	SAND
2.60	3.93	4.57	0.00	262.	0.43		72.1	43.9	0.71	42.0	0.61	1.5	443.	SAND
2.80	4.29	5.36	0.00	348.	0.45		83.2	44.4	0.74	42.6	0.70	1.6	615.	SAND
3.00	5.40	4.28	0.00	364.	0.58		94.6	44.4	0.77	42.7	1.19	2.6	715.	SAND
3.20	5.91	4.24	0.00	411.	0.62		109.2	44.9	0.80	43.2	1.41	3.0	839.	SAND
3.40	4.54	3.95	0.00	305.	0.52		95.0	43.6	0.83	41.9	1.01	2.1	553.	SAND
3.60	3.88	4.53	0.00	309.	0.42		88.7	44.0	0.86	42.4	0.71	1.4	519.	SAND
3.80	4.82	3.85	0.00	338.	0.61		78.7	42.5	0.88	40.9	1.40	2.7	630.	SAND
4.00	3.53	4.13	0.00	282.	0.47		73.7	42.4	0.91	40.8	0.86	1.6	456.	SAND
4.20	2.76	5.34	0.00	206.	0.27		93.5	44.3	0.95	42.9	0.33	0.6	395.	SAND
4.40	3.97	4.41	0.00	349.	0.43		103.0	44.1	0.98	42.7	0.83	1.4	593.	SAND
4.60	3.06	4.61	0.00	290.	0.40		78.9	42.5	0.99	41.1	0.68	1.1	427.	SAND
4.80	2.27	5.18	0.00	249.	0.35		64.5	41.4	1.01	39.9	0.51	0.8	301.	SAND
5.00	2.04	6.61	0.00	292.	0.26		80.7	42.9	1.05	41.5	0.31	0.5	327.	SAND
5.20	2.07	6.43	0.00	297.	0.25		85.5	43.1	1.08	41.8	0.31	0.5	336.	SAND
5.40	2.03	6.70	0.00	310.	0.24		88.6	43.2	1.11	41.9	0.29	0.4	345.	SAND
5.60	1.74	8.06	0.00	327.	0.29		66.2	41.1	1.12	39.8	0.39	0.6	320.	SAND
5.80	1.44	9.78	0.00	337.	0.19		84.0	42.8	1.16	41.6	0.18	0.3	287.	SAND
6.00	2.48	6.31	0.00	383.	0.21		122.5	44.7	1.20	43.6	0.27	0.4	494.	SAND
6.20	3.72	4.49	0.00	419.	0.37		137.3	44.6	1.23	43.5	0.50	1.1	689.	SAND
6.40	3.51	4.50	0.00	406.	0.42		112.1	43.2	1.25	42.0	0.99	1.3	646.	SAND
6.60	1.63	5.17	0.00	222.									205.	SAND

END OF SOUNDING

PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

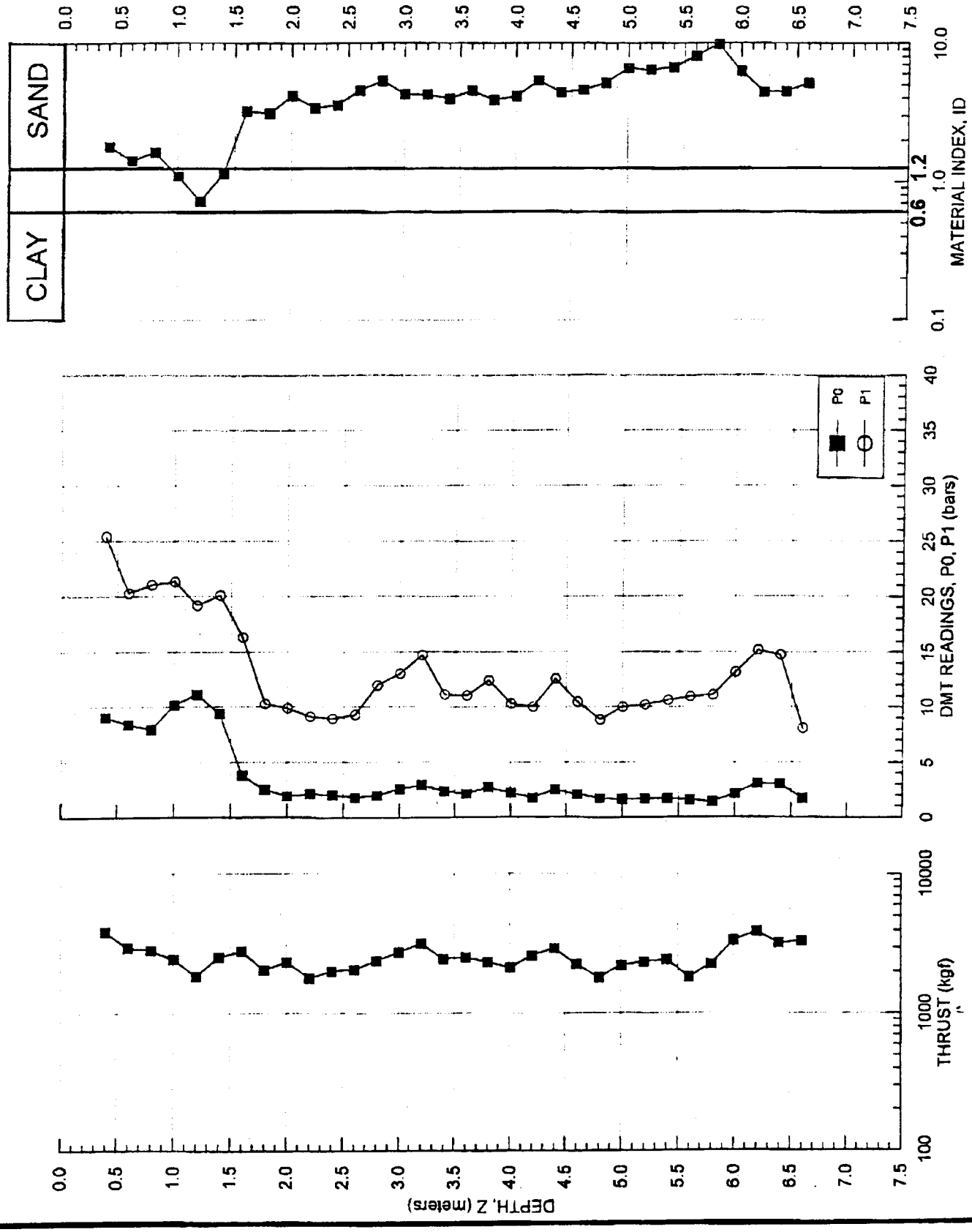
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 7-2-97

SOUNDING

270DP-4

DILATOMETER RESULTS

Ground Surface Elev.: ~5.0 m
Water Depth: ~1.9 m



PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

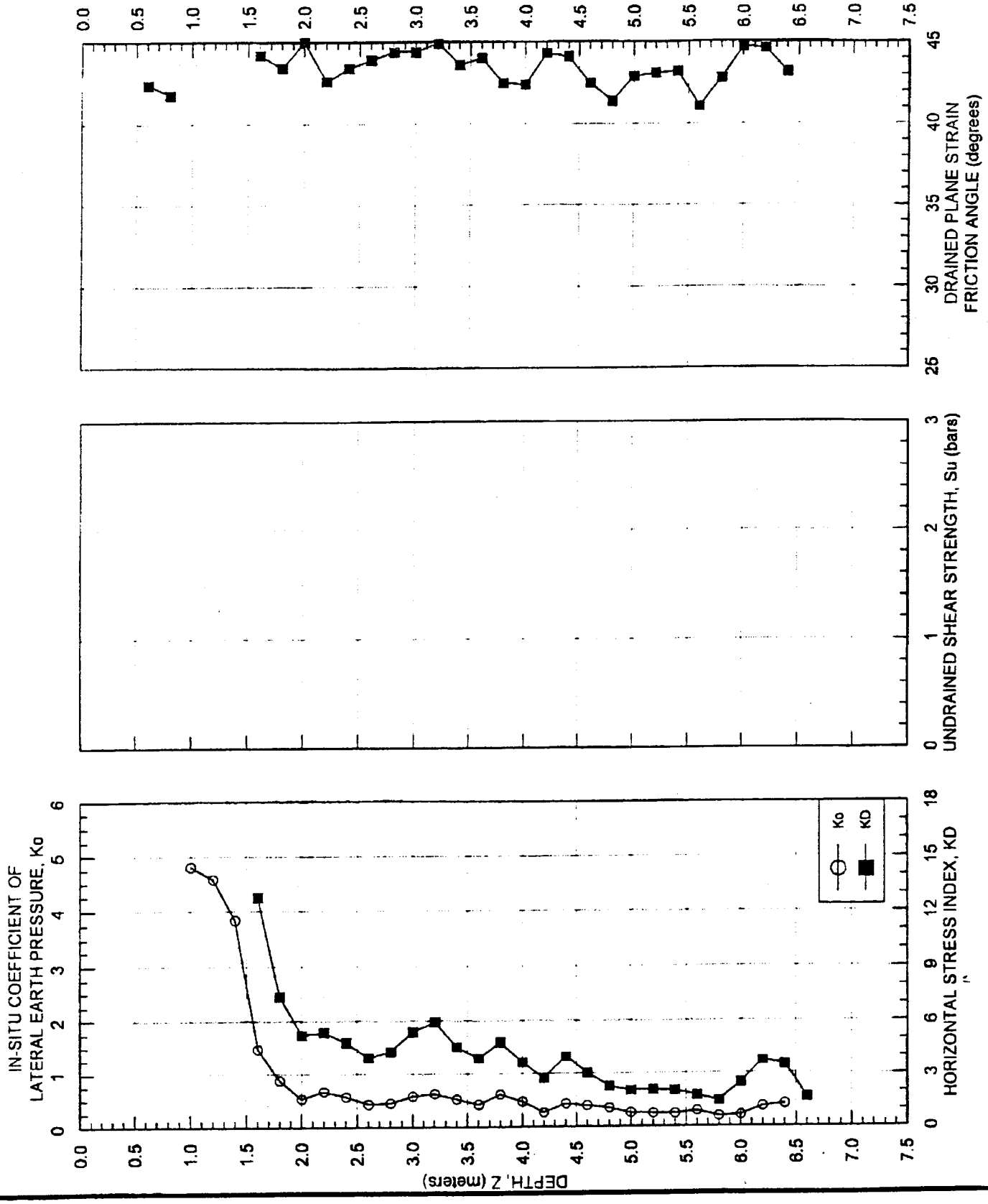
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

INTERPRETED DMT STRENGTH PARAMETERS

270DP-4

Ground Surface Elev.: ~5.0 m
Water Depth: ~1.9 m



PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

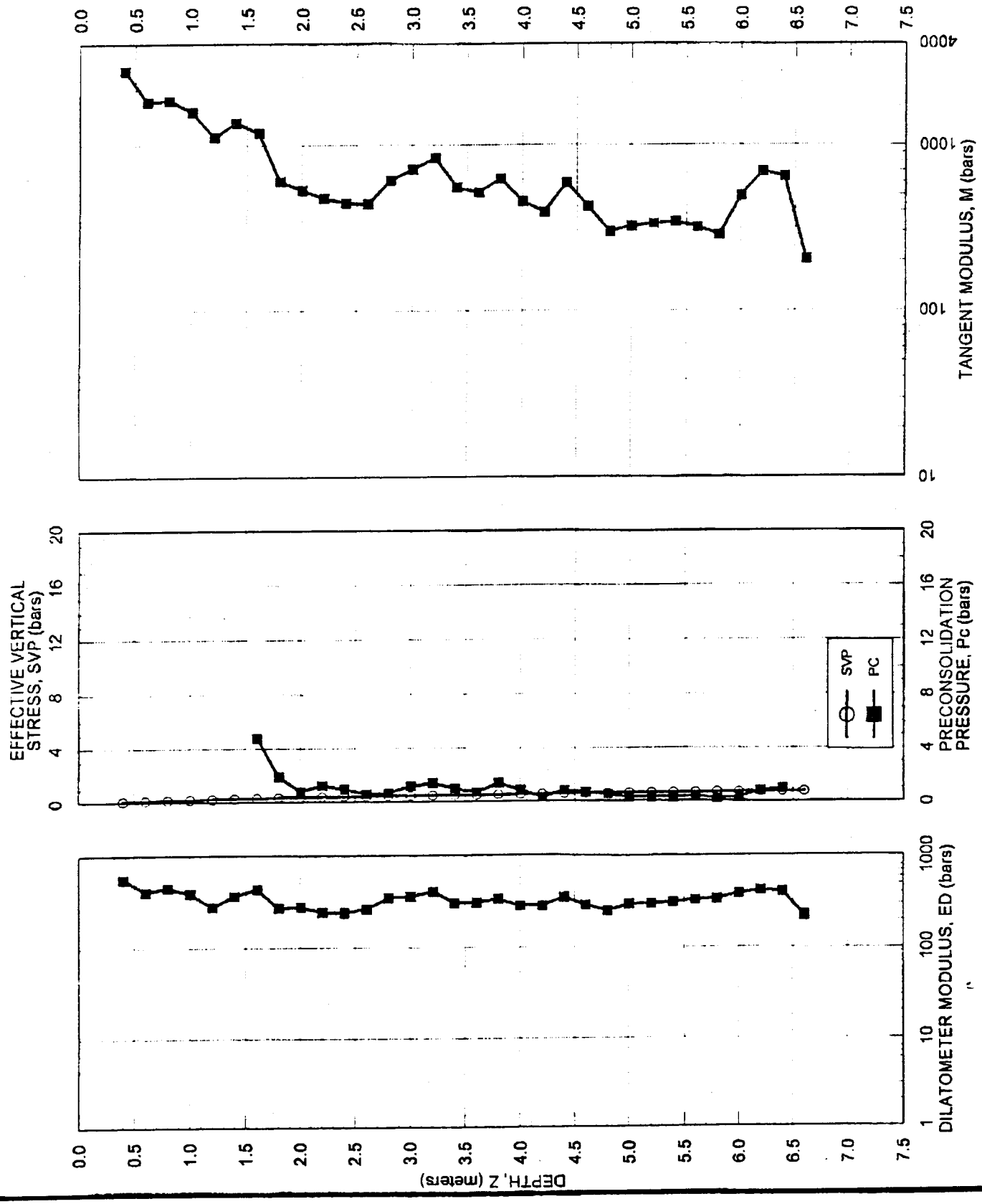
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

270DP-4

INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~5.0 m
Water Depth: ~1.9 m



DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP 5
PAGE 1
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 1.90 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.00 BARS
HI GAGE 0 = 0.00 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.19 BARS
DELTA-B = 0.13 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
KO FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.20	1790.	8.32	20.75		0.19	0.13	9.98	0.00	0.00	0.00	7.90	20.62		0.000	1.95	0.035
0.40	3500.	4.15	13.55		0.19	0.13	9.98	0.00	0.00	0.00	3.89	13.42		0.000	1.90	0.073
0.60	1500.	2.06	4.48		0.19	0.13	9.98	0.00	0.00	0.00	2.14	4.35		0.000	1.70	0.108
0.80	900.	2.39	6.20		0.19	0.13	9.98	0.00	0.00	0.00	2.41	6.07		0.000	1.70	0.141
1.00	980.	3.02	5.71		0.19	0.13	9.98	0.00	0.00	0.00	3.09	5.58		0.000	1.70	0.175
1.20	1100.	5.44	10.85		0.19	0.13	9.98	0.00	0.00	0.00	5.38	10.72		0.000	1.80	0.209
1.40	1130.	6.58	12.00		0.19	0.13	9.98	0.00	0.00	0.00	6.51	11.87		0.000	1.95	0.246
1.60	1340.	6.74	13.45		0.19	0.13	9.98	0.00	0.00	0.00	6.61	13.32		0.000	1.95	0.284
1.80	1480.	7.32	15.80		0.19	0.13	9.98	0.00	0.00	0.00	7.10	15.67		0.000	1.95	0.323
2.00	1370.	6.67	12.35		0.19	0.13	9.98	0.00	0.00	0.00	6.59	12.22		0.010	1.95	0.352
2.20	960.	5.31	7.78		0.19	0.13	9.98	0.00	0.00	0.00	5.39	7.65		0.029	1.80	0.368
2.40	660.	4.61	7.79		0.19	0.13	9.98	0.00	0.00	0.00	4.66	7.66		0.049	1.80	0.384
2.60	760.	3.16	4.30		0.19	0.13	9.98	0.00	0.00	0.00	3.31	4.17		0.069	1.70	0.399
2.80	1990.	2.43	9.78		0.19	0.13	9.98	0.00	0.00	0.00	2.27	9.65		0.088	1.90	0.414
3.00	2000.	2.71	9.93		0.19	0.13	9.98	0.00	0.00	0.00	2.55	9.80		0.108	1.90	0.432
3.20	2380.	2.57	10.10		0.19	0.13	9.98	0.00	0.00	0.00	2.40	9.97		0.128	1.90	0.450
3.40	2820.	3.59	13.25		0.19	0.13	9.98	0.00	0.00	0.00	3.31	13.12		0.147	1.90	0.467
3.60	2750.	3.16	12.30		0.19	0.13	9.98	0.00	0.00	0.00	2.91	12.17		0.167	1.90	0.485
3.80	2440.	2.81	10.65		0.19	0.13	9.98	0.00	0.00	0.00	2.62	10.52		0.186	1.90	0.503
4.00	2190.	2.40	9.82		0.19	0.13	9.98	0.00	0.00	0.00	2.23	9.69		0.206	1.90	0.520
4.20	2030.	2.18	9.23		0.19	0.13	9.98	0.00	0.00	0.00	2.03	9.10		0.226	1.90	0.538
4.40	2290.	2.09	9.31		0.19	0.13	9.98	0.00	0.00	0.00	1.93	9.18		0.245	1.80	0.555
4.60	2460.	2.80	12.35		0.19	0.13	9.98	0.00	0.00	0.00	2.53	12.22		0.265	1.90	0.571
4.80	3170.	2.77	13.65		0.19	0.13	9.98	0.00	0.00	0.00	2.43	13.52		0.285	1.90	0.589
5.00	2910.	2.34	12.55		0.19	0.13	9.98	0.00	0.00	0.00	2.04	12.42		0.304	1.90	0.607
5.20	2000.	2.42	11.60		0.19	0.13	9.98	0.00	0.00	0.00	2.17	11.47		0.324	1.90	0.624
5.40	1420.	2.16	9.37		0.19	0.13	9.98	0.00	0.00	0.00	2.01	9.24		0.343	1.80	0.641
5.60	1200.	1.75	7.72		0.19	0.13	9.98	0.00	0.00	0.00	1.66	7.59		0.363	1.80	0.657
5.80	1430.	1.76	8.00		0.19	0.13	9.98	0.00	0.00	0.00	1.65	7.87		0.383	1.80	0.672
6.00	2090.	1.95	10.30		0.19	0.13	9.98	0.00	0.00	0.00	1.74	10.17		0.402	1.80	0.688
6.20	3000.	2.65	13.00		0.19	0.13	9.98	0.00	0.00	0.00	2.34	12.87		0.422	1.90	0.705
6.40	2110.	2.78	11.30		0.19	0.13	9.98	0.00	0.00	0.00	2.56	11.17		0.442	1.90	0.722
6.60	1750.	1.98	8.75		0.19	0.13	9.98	0.00	0.00	0.00	1.85	8.62		0.461	1.80	0.739

END OF SOUNDING

(INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-5
PAGE 2
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 1.90 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.96 BARS
LO GAGE 0 = 0.00 BARS
HI GAGE 0 = 0.00 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.19 BARS
DELTA-B = 0.13 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
KO FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	KD	ID	UD	ED (BAR)	KO	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.20	225.84	1.61	0.00	441.									2405.	SANDY SILT
0.40	53.39	2.45	0.00	331.									1352.	SILTY SAND
0.60	19.84	1.03	0.00	77.	2.77						3.88	35.9	241.	SILT
0.80	17.00	1.52	0.00	127.	2.16		23.2	40.3	0.23	36.4	4.71	33.3	382.	SANDY SILT
1.00	17.68	0.80	0.00	86.	2.59						5.24	30.0	262.	CLAYEY SILT
1.20	25.70	0.99	0.00	185.	3.20						11.23	53.7	629.	SILT
1.40	26.48	0.82	0.00	186.	3.26						13.84	56.3	636.	CLAYEY SILT
1.60	23.25	1.01	0.00	233.	3.03						13.06	45.9	768.	SILT
1.80	22.02	1.21	0.00	297.	2.90		26.8	35.2	0.51	32.1	21.72	67.3	965.	SANDY SILT
2.00	18.75	0.86	0.00	195.	2.68						11.53	32.8	604.	CLAYEY SILT
2.20	14.57	0.42	0.00	78.	2.31	0.97					8.15	22.1	224.	SILTY CLAY
2.40	12.00	0.65	0.00	104.	2.06						6.29	16.4	279.	CLAYEY SILT
2.60	8.13	0.27	0.00	30.	1.61	0.51					3.55	8.9	68.	CLAY
2.80	8.26	3.39	0.00	256.	0.65		66.4	42.8	0.70	40.8	1.27	3.1	498.	SAND
3.00	8.67	2.96	0.00	251.	0.72		65.5	42.3	0.72	40.4	1.60	3.7	504.	SILTY SAND
3.20	8.05	3.33	0.00	263.	0.58		80.8	43.6	0.76	41.8	1.15	2.6	501.	SAND
3.40	6.77	3.10	0.00	340.	0.80		93.0	43.6	0.79	41.8	2.19	4.7	736.	SILTY SAND
3.60	5.65	3.38	0.00	321.	0.65		92.6	43.7	0.82	42.0	1.54	3.2	644.	SAND
3.80	4.85	3.24	0.00	274.	0.58		82.6	43.1	0.85	41.4	1.27	2.5	513.	SILTY SAND
4.00	3.90	3.67	0.00	259.	0.49		75.3	42.7	0.87	41.1	0.91	1.8	435.	SAND
4.20	3.36	3.91	0.00	245.	0.44		70.4	42.3	0.90	40.7	0.76	1.4	381.	SAND
4.40	3.05	4.29	0.00	251.	0.36		81.0	43.2	0.93	41.7	0.55	1.0	369.	SAND
4.60	3.96	4.28	0.00	336.	0.48		88.3	43.1	0.96	41.6	0.97	1.7	570.	SAND
4.80	3.65	5.16	0.00	385.	0.36		112.2	44.7	1.00	43.3	0.61	1.0	625.	SAND
5.00	3.85	6.00	0.00	360.	0.29		100.8	44.2	1.03	42.8	0.41	0.7	508.	SAND
5.20	2.95	5.05	0.00	323.	0.43		69.5	41.4	1.04	39.9	0.80	1.3	465.	SAND
5.40	2.59	4.35	0.00	251.	0.47		48.6	38.9	1.04	37.4	0.88	1.4	333.	SAND
5.60	1.97	4.58	0.00	206.	0.42		42.1	38.0	1.06	36.4	0.69	1.1	224.	SAND
5.80	1.89	4.89	0.00	216.	0.38		50.9	39.2	1.10	37.7	0.59	0.9	227.	SAND
6.00	1.94	6.31	0.00	293.	0.29		75.8	41.8	1.15	40.5	0.41	0.6	315.	SAND
6.20	2.72	5.50	0.00	365.	0.30		107.5	43.6	1.19	42.5	0.50	0.7	500.	SAND
6.40	2.93	4.06	0.00	299.	0.45		72.8	40.7	1.19	39.4	1.00	1.4	429.	SAND
6.60	1.88	4.89	0.00	235.	0.35		62.8	40.0	1.21	38.7	0.58	0.8	246.	SAND

END OF SOUNDING

PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

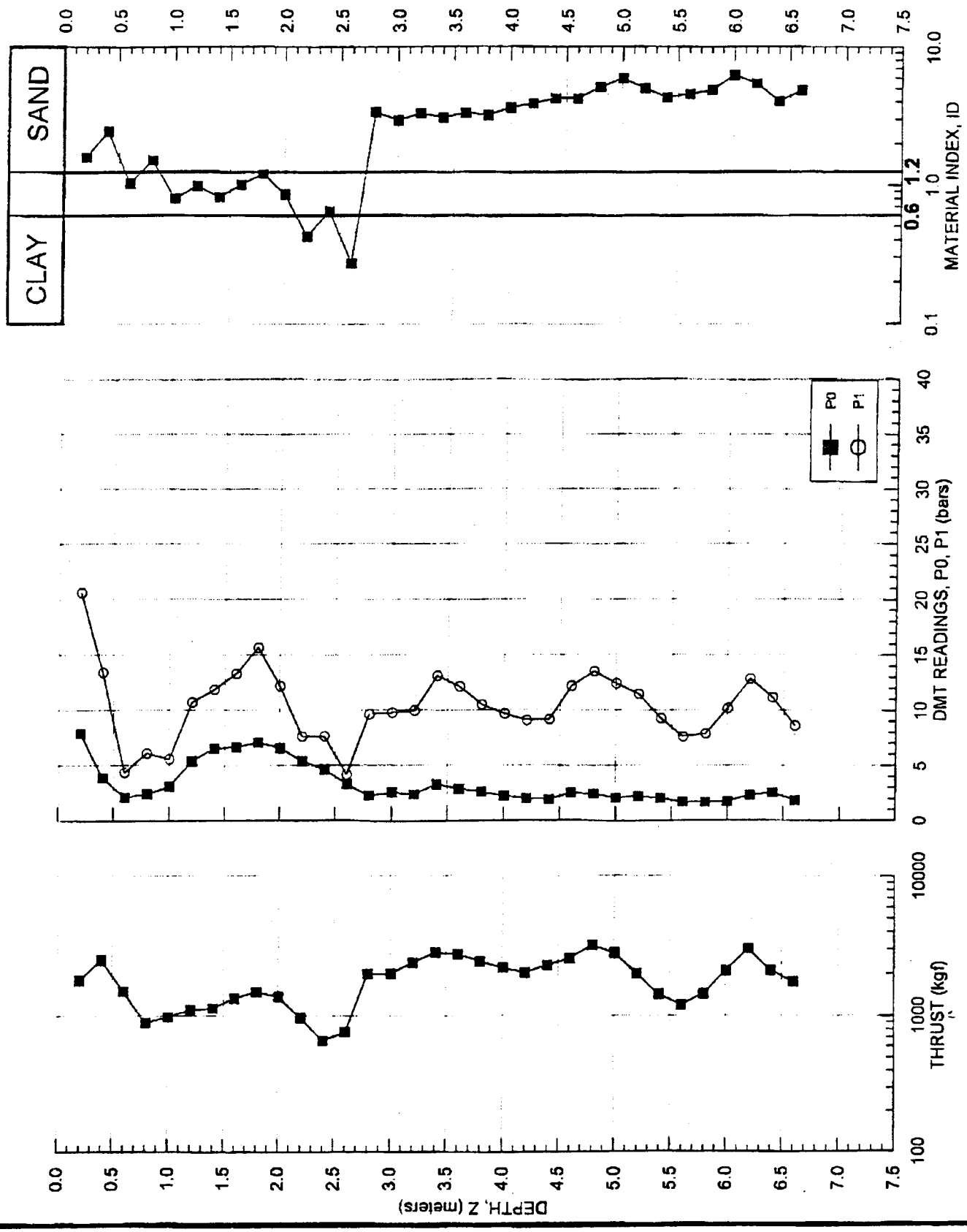
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 7-2-97

SOUNDING

DILATOMETER RESULTS

270DP-5

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.5 m



PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

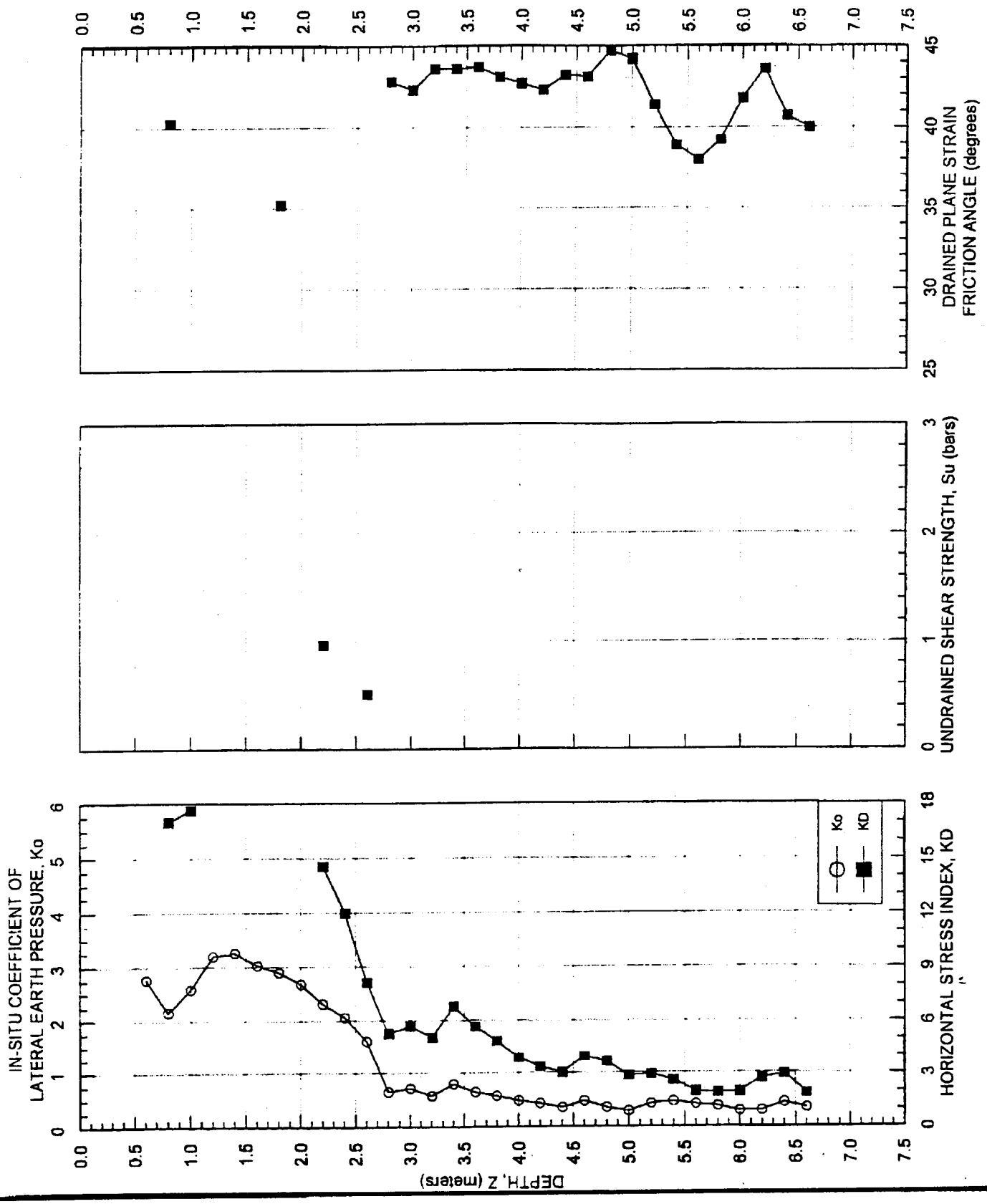
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

INTERPRETED DMT STRENGTH PARAMETERS

270DP-5

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.5 m



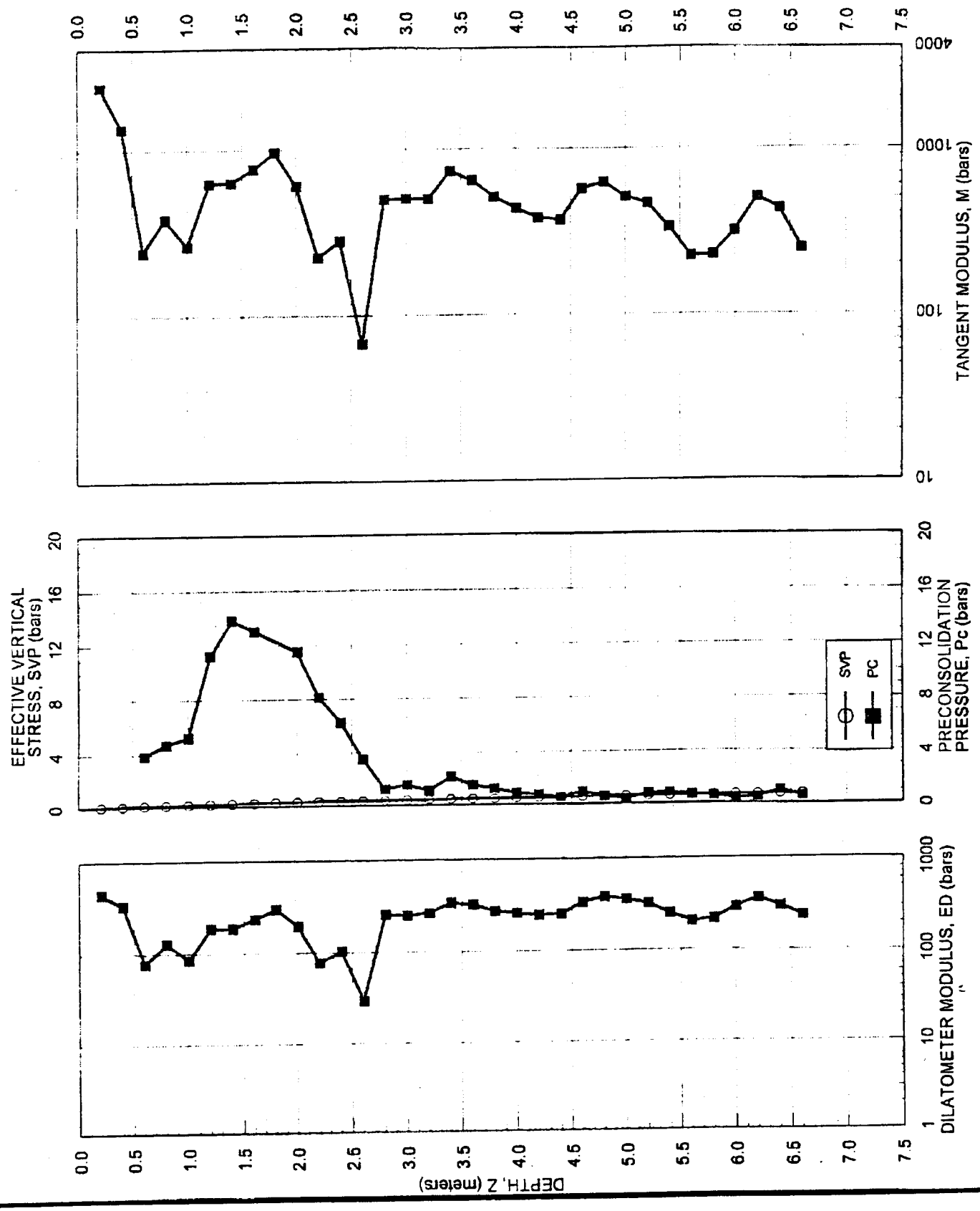
PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING
270DP-5

INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.5 m



DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN-SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP-6
PAGE 1
FILE NO. : IST-9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 2.50 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.01 BARS
HI GAGE 0 = 0.00 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.13 BARS
DELTA-B = 0.23 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
K0 FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.40	2260.	3.92	10.50		0.13	0.23	9.98	0.01	0.00	0.00	3.73	10.27		0.000	1.80	0.070
0.60	1250.	3.15	7.47		0.13	0.23	9.98	0.01	0.00	0.00	3.07	7.23		0.000	1.80	0.105
0.80	590.	1.93	3.80		0.13	0.23	9.98	0.01	0.00	0.00	1.97	3.56		0.000	1.70	0.140
1.00	400.	1.39	2.37		0.13	0.23	9.98	0.01	0.00	0.00	1.48	2.13		0.000	1.60	0.172
1.20	330.	1.28	2.35		0.13	0.23	9.98	0.01	0.00	0.00	1.36	2.11		0.000	1.60	0.203
1.40	430.	1.31	2.75		0.13	0.23	9.98	0.01	0.00	0.00	1.38	2.51		0.000	1.60	0.235
1.60	430.	1.55	3.01		0.13	0.23	9.98	0.01	0.00	0.00	1.61	2.77		0.000	1.60	0.266
1.80	340.	1.69	3.05		0.13	0.23	9.98	0.01	0.00	0.00	1.76	2.81		0.000	1.60	0.298
2.00	290.	1.78	2.83		0.13	0.23	9.98	0.01	0.00	0.00	1.87	2.59		0.000	1.60	0.329
2.20	300.	1.75	2.47		0.13	0.23	9.98	0.01	0.00	0.00	1.85	2.23		0.000	1.60	0.360
2.40	1230.	1.90	5.67		0.13	0.23	9.98	0.01	0.00	0.00	1.85	5.43		0.000	1.80	0.394
2.60	2060.	2.14	8.46		0.13	0.23	9.98	0.01	0.00	0.00	1.96	8.22		0.010	1.90	0.420
2.80	2410.	2.87	9.77		0.13	0.23	9.98	0.01	0.00	0.00	2.66	9.53		0.029	1.90	0.438
3.00	1420.	2.66	6.32		0.13	0.23	9.98	0.01	0.00	0.00	2.62	6.08		0.049	1.70	0.454
3.20	2070.	2.11	9.63		0.13	0.23	9.98	0.01	0.00	0.00	1.87	9.39		0.069	1.90	0.469
3.40	2650.	2.88	11.85		0.13	0.23	9.98	0.01	0.00	0.00	2.57	11.62		0.088	1.90	0.487
3.60	2420.	3.18	12.20		0.13	0.23	9.98	0.01	0.00	0.00	2.87	11.97		0.108	1.90	0.505

END OF SOUNDING

(INTERPRETED SOIL PARAMETERS ON NEXT PAGE)

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
IN SITU SOIL TESTING, L.C.
JOB FILE: AVIAATION SUPPORT FACILITY -- FORT EUSTIS, VIRGINIA
LOCATION: AS PLANNED
SNDG.BY : R. FAILMEZGER
ANAL.BY : R. FAILMEZGER

SNDG. NO. 270DP 6
PAGE 2
FILE NO. : IST 9716

SNDG.DATE: 7-2-97
ANAL.DATE: 7-3-97

ANALYSIS PARAMETERS:
SURF.ELEV. = 5.00 M
WATER DEPTH = 2.50 M
SP.GR.WATER = 1.000
MAX SU ID = 0.60

LO RANGE = 9.98 BARS
LO GAGE 0 = 0.01 BARS
HI GAGE 0 = 0.00 BARS
CAL GAGE 0 = 0.00 BARS
SU OPTION = MARCHETTI

ROD DIAM. = 3.57 CM
FR.RED.DIA. = 4.80 CM
LIN.ROD WT. = 6.50 KGF/M
DELTA/PHI = 0.50
MIN PHI ID = 1.20

BL.THICK. = 15.0 MM
BL.WIDTH = 96.0 MM
DELTA-A = 0.13 BARS
DELTA-B = 0.23 BARS
OCR OPTION= MARCHETTI

SU FACTOR = 1.00
PHI FACTOR = 1.00
OCR FACTOR = 1.00
M FACTOR = 1.00
K0 FACTOR = 1.00

UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.40	33.26	1.75	0.00	227.									927.	SANDY SILT
0.60	29.17	1.35	0.00	144.	3.54		32.4	42.4	0.18	38.3	9.34	88.7	507.	SANDY SILT
0.80	14.14	0.80	0.00	55.	2.27						2.95	21.1	156.	CLAYEY SILT
1.00	8.60	0.44	0.00	23.	1.67	0.23					1.67	9.7	53.	SILTY CLAY
1.20	6.71	0.55	0.00	26.	1.42	0.20					1.34	6.6	54.	SILTY CLAY
1.40	5.86	0.82	0.00	39.	1.30						1.26	5.3	77.	CLAYEY SILT
1.60	6.07	0.72	0.00	40.	1.33						1.50	5.6	80.	CLAYEY SILT
1.80	5.91	0.60	0.00	36.	1.31	0.25					1.61	5.4	71.	SILTY CLAY
2.00	5.67	0.39	0.00	25.	1.27	0.27					1.67	5.1	48.	SILTY CLAY
2.20	5.14	0.20	0.00	13.	1.18	0.26					1.57	4.4	24.	CLAY
2.40	4.70	1.94	0.00	124.	0.69		39.4	40.0	0.65	37.7	1.25	3.2	223.	SILTY SAND
2.60	4.64	3.21	0.00	217.	0.55		70.2	43.4	0.71	41.5	0.94	2.2	398.	SILTY SAND
2.80	6.01	2.61	0.00	238.	0.71		80.0	43.4	0.74	41.5	1.65	3.8	487.	SILTY SAND
3.00	5.66	1.35	0.00	120.	0.82		43.4	39.4	0.74	37.3	2.05	4.5	234.	SANDY SILT
3.20	3.84	4.17	0.00	261.	0.46		71.6	43.1	0.79	41.3	0.75	1.6	435.	SAND
3.40	5.09	3.65	0.00	314.	0.58		90.1	43.8	0.82	42.1	1.24	2.6	601.	SAND
3.60	5.47	3.30	0.00	316.	0.68		80.1	42.7	0.85	40.9	1.69	3.4	624.	SAND

END OF SOUNDING

PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

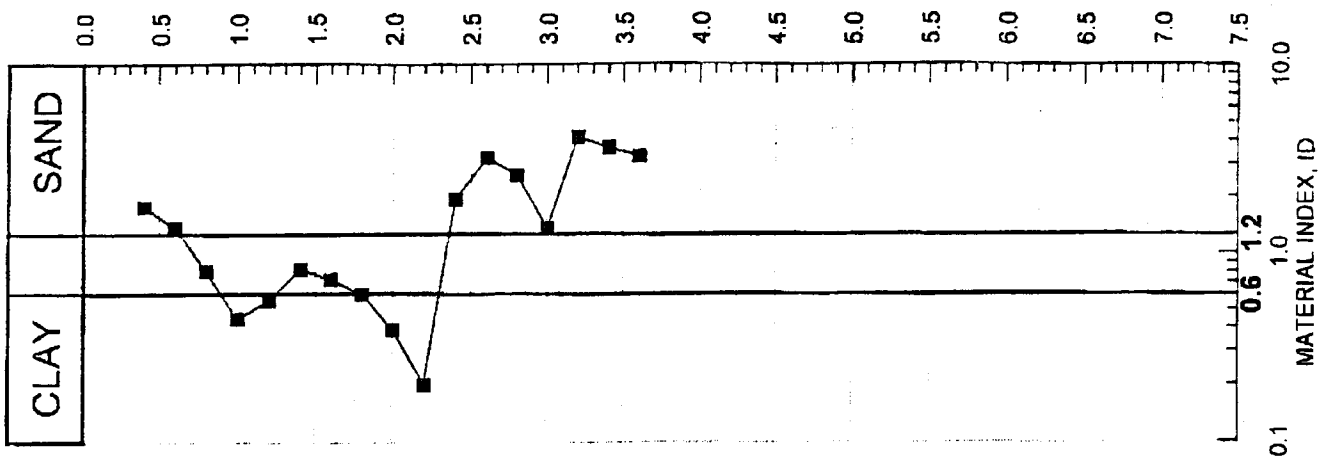
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 7-2-97

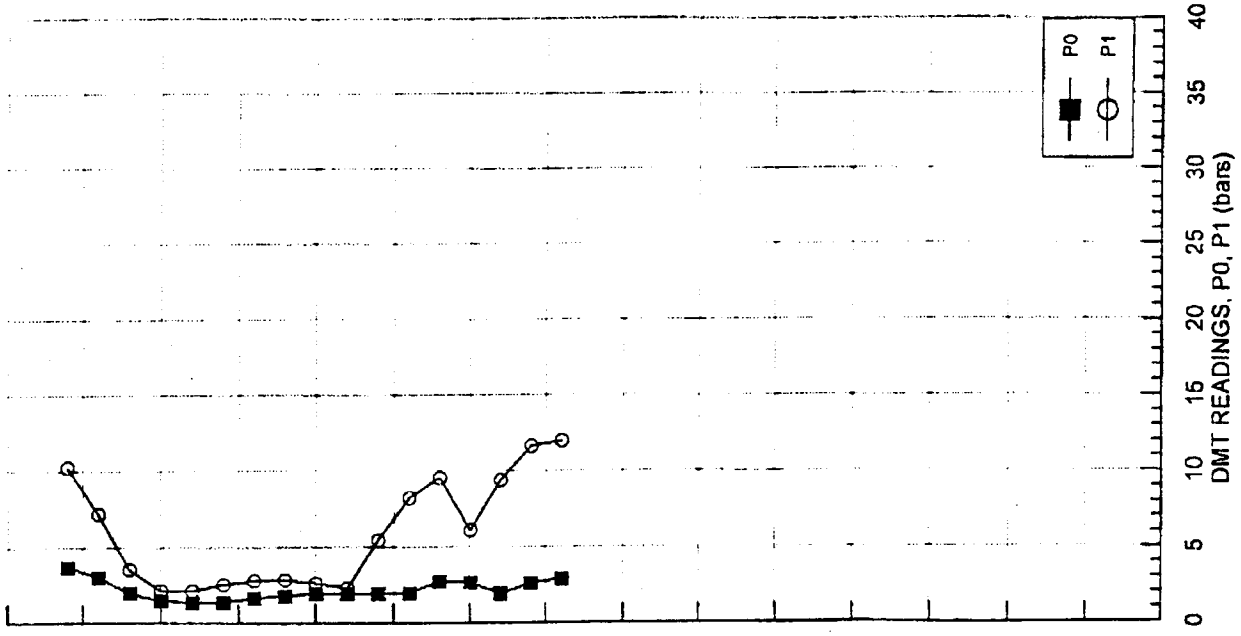
SOUNDING

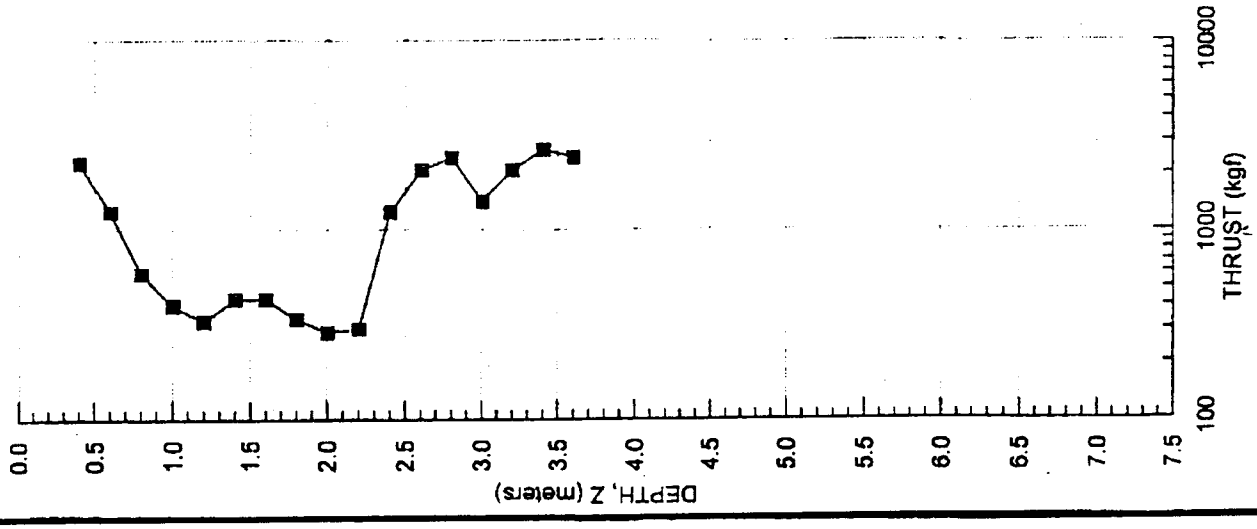
270DP-6

DILATOMETER RESULTS

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.5 m







PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

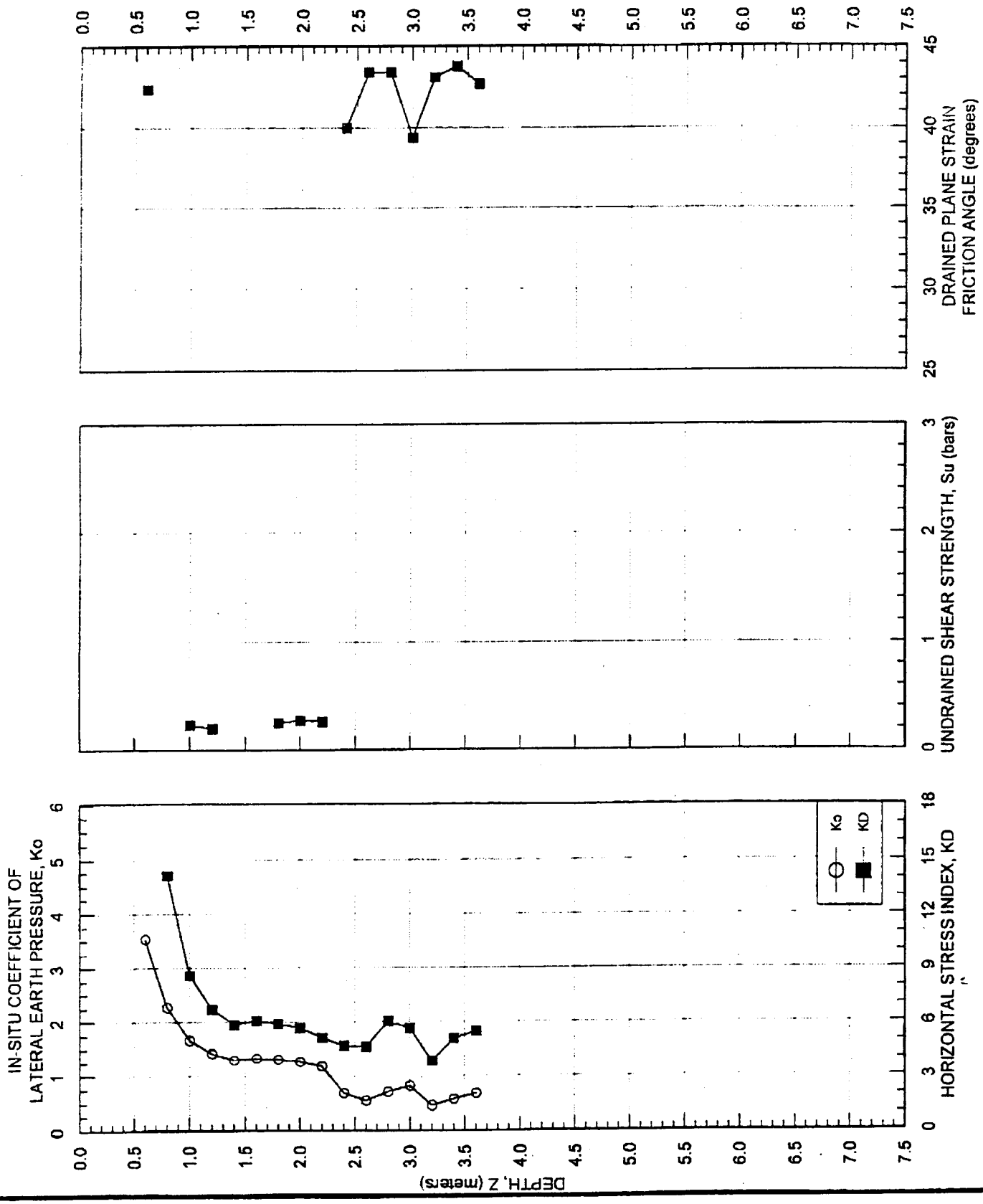
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

INTERPRETED DMT STRENGTH PARAMETERS

270DP-6

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.5 m



PROJECT: AVIATION SUPPORT FACILITY
LOCATION: Fort Eustis, Virginia

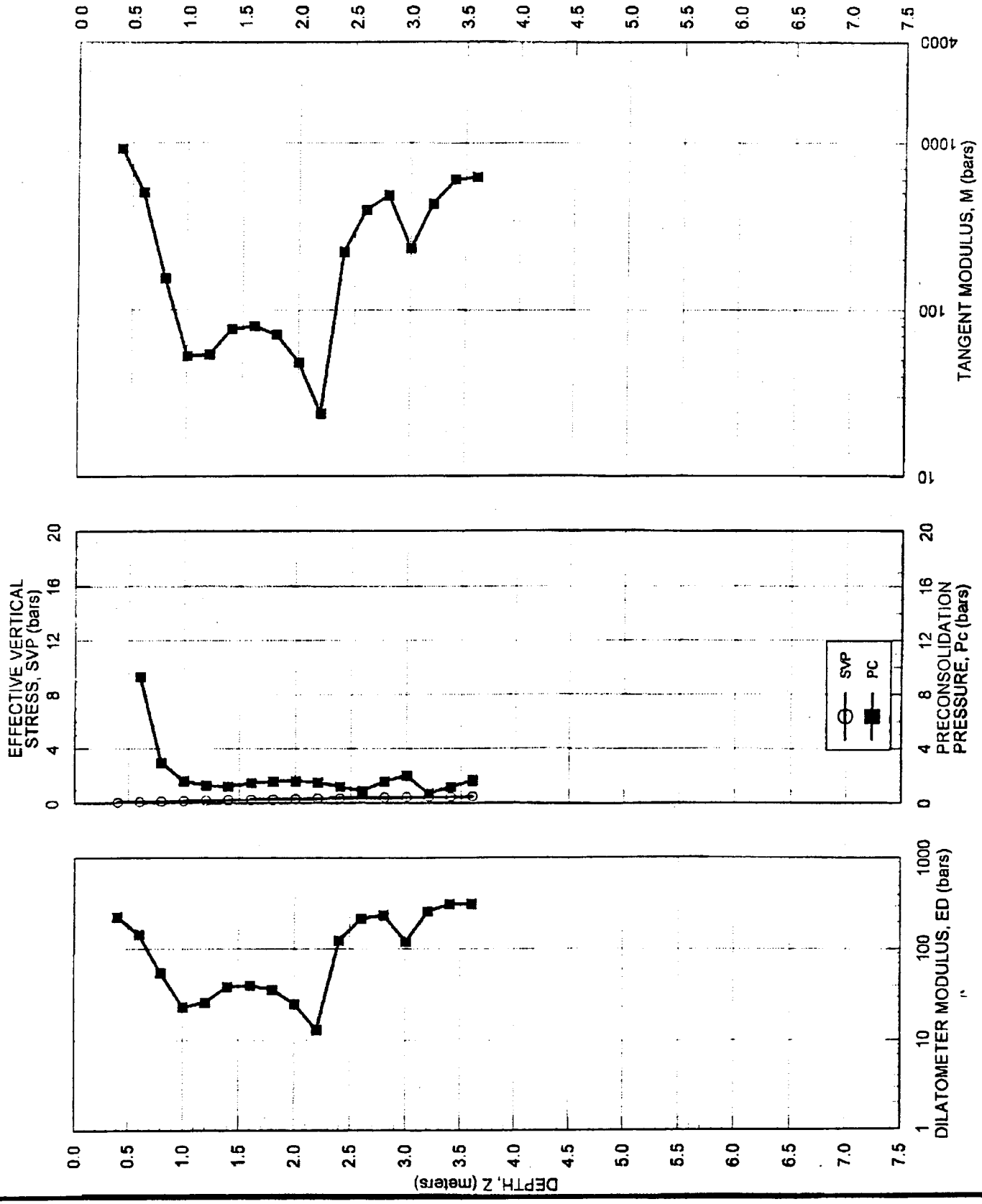
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Fai mezger
SOUNDING DATE 7-2-97

SOUNDING

270DP-6

INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~5.0 m
Water Depth: ~2.5 m



SECTION 01090

SOURCES FOR REFERENCE PUBLICATIONS

03/98

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Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the sponsoring organization, e.g. UL 1 (1993; Rev thru Jan 1995) Flexible Metal Conduit. However, when the sponsoring organization has not assigned a number to a document, an identifying number has been assigned for convenience, e.g. UL's unnumbered 1995 edition of their Building Materials Directory is identified as UL-01 (1995) Building Materials Directory. The sponsoring organization number (UL 1) can be distinguished from an assigned identifying number (UL-1) by the dash mark (-).

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PART 2 NOT USED

PART 3 NOT USED

-- End of Section --

SECTION 01111
SAFETY AND HEALTH REQUIREMENTS

03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS

EM 385-1-1	(1996) Safety and Health Requirements Manual

CODE OF FEDERAL REGULATIONS

29 CFR 1910	Occupational Safety and Health Standards, General Industry.
29 CFR 1926	Occupational Safety and Health Standards, Construction Industry.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 SD Data

Safety and Health Plan (Accident Prevention Plan); GA.

1.3 SAFETY REQUIREMENTS AND ACCIDENT PREVENTION

1.3.l Standards

The Contractor shall comply with Occupational Safety and Health Act (OSHA) Standards, the Corps of Engineers Manual EM 385-1-1, "Safety and Health Requirements Manual," NFPA 101, and state, local, and facility safety requirements.

1.4 SAFETY AND HEALTH PLAN

1.4.1 Preparation and Implementation

An Accident Prevention Plan (APP) shall be prepared covering onsite work to be performed by the Contractor and all subcontractors, and shall at a minimum address the requirements for an Accident Prevention Plan (APP), as contained in Appendix A, EM 385-1-1. The Safety and Health Manager shall be responsible for the development, implementation and oversight of the APP. The APP shall establish, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed. The APP shall address general safety and health requirements and procedures. The level of detail provided in the APP shall be tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available

when the initial APP is prepared and submitted. Therefore, the APP shall address, in as much detail as possible, anticipated tasks, their related hazards and anticipated control measures.

1.4.2 Acceptance and Modifications

Prior to submittal, the APP shall be signed and dated by the Contractor's Safety and Health Manager and the Site Superintendent. The APP shall be submitted for review at least 10 days prior to the Prework Safety Conference. Deficiencies in the APP will be discussed at the Prework Safety Conference, and the APP shall be revised to correct the deficiencies and resubmitted for acceptance. Onsite work shall not begin until the plan has been accepted. A copy of the written APP shall be maintained onsite. As work proceeds, the APP shall be adapted to new situations and new conditions. Changes and modifications to the accepted APP shall be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, shall bring such hazard to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP shall be cause for stopping of work until the matter has been rectified to the satisfaction of the Contracting Officer.

1.5 Corps of Engineers Standards

Corps of Engineers Manual EM 385-1-1, referred to in "ACCIDENT PREVENTION" article of Contract Clauses, is hereby supplemented or revised as follows:

1.5.1 Conflicts

When a conflict exists between the Corps of Engineers Safety and Health Requirements Manual, other safety requirements, or the contract plans and/or specifications, the most stringent requirement shall prevail. (NAOSA 5 FEB 87).

1.5.2 Front End Loader - Backhoe Machines

1.5.2.1 Non-compliance Safety Check

All front end loader-backhoe machines and other machines, such as tractors that utilize a backhoe attachment, shall be checked for:

a. Exposed backhoe boom swing foot pedals.

b. Backhoe boom swing lever which can be reached by a man standing on the ground or on the outrigger support bracket.

1.5.2.2 Correction and Fabrication of Non-compliance Safety Items

Where these conditions exist, guards shall be fabricated to:

a. Cover over exposed foot pedals to prevent someone from accidentally stepping on them.

b. Inclose the swing lever so as to preclude operation from the ground or from the outrigger support bracket.

1.5.3 Attendance at Safety Meetings

In order to allow for maximum attendance at weekly tool box meetings and monthly supervisor meetings by Corps of Engineers personnel, the Contractor shall advise the CO's Office, a minimum of 48 hours before the start of each meeting, of the date, time and location of Safety Meetings.

1.5.3.1 Minutes of Safety Meetings

Minutes shall be prepared by the Contractor and forwarded to the Contracting Officer by close of business the next work day.

1.5.4 Protective Footwear

Protective footwear as defined by American National Standards Institute Z41 shall be worn by all working personnel on site.

1.5.5 Ground Fault Circuit Interrupters (GFCI)

GFCI's are required for work on this contract in accordance with EM 385-1-1. GFCI's are also required when using electric power extension cords.

1.5.6 Crawler-, Truck-, and Wheel-Mounted Cranes

Implementation of paragraph 16.D.05 shall include the following:

a. When a crane is performing duty cycle work (such as clamshell, dragline, grapple, or pile driving) it does not require anti-two block equipment. If the crane is required to make a non-duty cycle lift (for example, to lift a piece of equipment, a tool box, or supplies), it will be exempt from the anti-two block equipment requirements if the following procedures are implemented:

(1) an international orange warning device (warning flag, warning tape, or warning ball) is properly secured to the hoist line at a distance of 8 to 10 feet above the hoist rigging;

(2) the signalperson (or an individual designated as the signalperson) acts as a spotter to alert the crane operator with a "STOP" signal when the warning device approaches the boom tip and the crane operator ceases hoisting functions when alerted of this; and

(3) while the non-duty cycle lift is underway, the signal person shall not stand under the load, shall have no duties other than signalperson, and shall comply with the signaling requirements of EM 385-1-1;

b. Anti-two block devices are always required when hoisting personnel by crane or derrick.

PART 2 PRODUCTS (THIS PART NOT USED)

PART 3 EXECUTION (THIS PART NOT USED)

MASTER SPECIFICATION FOR MILITARY CONSTRUCTION

SECTION 01200
PROJECT MEETINGS

03/98

PART 1 GENERAL

1.1 SUBMITTALS (NOT APPLICABLE)

1.2 PRECONSTRUCTION CONFERENCE

1.2.1 Scheduling

After award of the construction contract and prior to the start of any construction work, the Contracting Officer (CO) will schedule and conduct a preconstruction conference. The Contractor's Project Manager, Superintendent and Quality Control System Manager shall attend this meeting. The Contractor is encouraged to have an officer of his company (Project Manager could be this person) and representation from each of his sub-contractors at the conference. This conference will be held at a location and time as specified by the CO.

1.2.2 Purpose

The purpose of this preconstruction conference is to enable the CO to outline the procedures that will be followed by the Government in its administration of this construction contract and to discuss the performance that will be expected from the Contractor. This conference will allow the Contractor an opportunity to ask questions about the Government's supervision and inspection of contract work, about security requirements, regulations, etc. The CO may invite Using Service personnel and any other Government personnel to attend this conference.

1.2.3 Discussion Items

The following is a list of items for discussion during the preconstruction conference. However, the Contracting Officer may include additional items for discussion as conditions and the work require.

a. Authority of the Area/Resident Engineer and organization of the Area/Resident office.

b. Contractor's Progress Schedule.

c. Correspondence Procedures.

d. Contractor Labor Standards Provisions.

e. Contract Modifications and Administrative Procedures.

f. Contractor's Administrative, Laydown and Storage Areas.

g. Procedures for Processing Submittals.

h. Payment Estimate Data and Procedures.

i. Contractor Utilities.

j. Security Requirements and Other Regulations, if applicable.

k. Government Furnished Equipment, if applicable.

l. Disposition of Salvage Property.

m. Contractor Insurance Requirements.

n. Value Engineering Program.

o. Contractor Performance Evaluation.

p. As-Built Drawings.

q. Warranty of Construction and Single Point of Contact.

r. Turnover of Completed Facilities.

1.3 OTHER MEETINGS

Other meetings are or may be scheduled to be held after the Preconstruction Conference, and such meetings may include the following:

a. Accident Prevention Safety Plan

b. Quality Control Plan.

c. Environmental Protection Plan.

d. Warranty Management Plan.

1.4 FACILITY MEETINGS

The Facility may also schedule meetings with the Contractor through the CO during the progress of construction work.

1.5 MINUTES OF MEETINGS

The Government will prepare minutes of the meeting and will provide the Contractor with a signed original for review and concurrence. The minutes shall include all items discussed at the meeting and the Government will make all corrections provided by the Contractor and resubmit the corrected minutes to the Contractor within seven days.

1.6 WARRANTY MANAGEMENT PLAN

The Contractor shall provide a Warranty Management Plan, not less than 30 days prior to the Post-Construction Warranty Conference. As a minimum, include a table, showing the below requirements, and attach certificates:

a. List of warranties provided.

b. List of equipment, names of manufacturers and suppliers and phone numbers.

c. Period of Warranties and Start Date.

d. List of Extended Warranties.

e. Warranty Certificates.

f. Single Point of Contact for Warranty of Construction.

PART 2 PRODUCTS (THIS PART NOT USED)

PART 3 EXECUTION (THIS PART NOT USED)

SECTION 01300
SUBMITTAL PROCEDURES

03/98

PART 1 GENERAL

1.1 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.1.1 Government Approved (GA)

Governmental approval (GA) is required for extensions of design, critical materials, deviations and/or departure from the contract documents, items of equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.1.2 For Information Only (FIO)

All submittals not requiring Government approval will be for information only (FIO). They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.2 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the CQC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.3 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.4 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications, and as indicated on the Submittal Register (ENG FORM 4288-R), attached hereto. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the CQC representative and each respective transmittal form (ENG FORM 4025-R) shall be stamped, signed, and dated by the CQC representative indicating action taken, and certifying that the accompanying submittal complies with the contract requirements. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and approved prior to the acquisition of the material or equipment covered thereby. FIO submittals shall be submitted at least 15 days prior to scheduled installation of the item(s). Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER (ENG FORM 4288-R, MAR 95)

At the end of this section is one set of ENG Form 4288-R listing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. Columns "d" through "p" have been completed by the Government; column "q" is reserved for use by the government; the Contractor shall complete columns "a", "b", "c", and "r" through "w" and submit the forms (hard copy) to the Contracting Officer for approval within thirty calendar days after Notice to Proceed. The Contractor shall keep the Submittal Register up-to-date and shall submit it to the Government together with the monthly payment request. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated. An updated Submittal Register shall be submitted no less than every sixty calendar days.

3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of thirty calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional fifteen calendar days (total forty-five calendar days) shall be allowed and shown on the register

for review and approval of submittals for refrigeration and HVAC control systems.

3.4 TRANSMITTAL FORM (ENG FORM 4025-R, MAR 95)

The transmittal form (ENG Form 4025-R) shall be used for submitting both GA and FIO submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor by the CO after award of the contract. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item. Submittals pertaining to different specifications sections shall not be submitted on the same transmittal form. A separate form shall be used for each specification section.

3.5 SUBMITTAL PROCEDURE

Submittal procedures shall be as follows:

3.5.1 Procedures

Procedures shall be incorporated into the Quality Control Plan required in Section 01440.

3.5.2 Procedures for Submittal of Samples

All samples of materials submitted as required by these specifications shall be properly identified and labeled for ready identification, and upon being certified, stored at the site of the work for jobsite use until all work has been completed and accepted by the CO.

3.5.3 Contractor Certification

Certification by the Contractor shall be accomplished by using Action Codes A or B in column "g" of ENG Form 4025-R. The Contractor shall sign and date Section II for Contractor certified submittals as well as sign the certification and Section I. Contractor certified drawings will be subject to quality assurance review by the Government at any time during the duration of the contract. No adjustment for time or money will be allowed for corrections required as a result of non-compliance with the contract documents.

3.5.4 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.7 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four copies of the submittal will be retained by the Contracting Officer and two copies of the submittal will be returned to the Contractor.

3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Provide four copies of FIO submittals. Approval of the CO is not required on FIO submittals. These submittals will be used for information purposes by the Government. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract documents. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications and will not prevent the CO from requiring removal and replacement if nonconforming material is incorporated in the work. This does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Rubber stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

```
_____________________________________________________________________
|                              CONTRACTOR                            |
|                                                                    |
|                              (Firm Name)                           |
|                                                                    |
|                                                                    |
|                                                                    |
| _____ Approved-(A)Certified to comply with the Contract documents. |
|                                                                    |
|                                                                    |
| _____ Approved-(B)Certified to comply with Contract documents with |
|                   exceptions or corrections as specifically noted on |
|                   the Submittal data and/or attached sheets.       |
|                                                                    |
|                                                                    |
| SIGNATURE:  ____________________________________________________   |
|                                                                    |
| TITLE:  _________________________________________________________  |
|                                                                    |
| DATE:  __________________________________________________________  |
|                                                                    |
|____________________________________________________________________|
```

-- End of Section --

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTIO

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		00800	SPECIAL CONTRACT REQUIREMENTS																					
		10.1	REAL PROPERTY EQUIPMENT LIST	X									X											
		10.2	MAINTENANCE AND EQUIPMENT	X									X											
		42	PROGRESS PHOTOGRAPHS										X											
		61	MECHANICAL ROOM LAYOUT		X									X										
		01005	PROJECT WORK REQUIREMENTS																					
			AND RESTRICTIONS																					
		1.17	CONSTRUCTION MANPOWER																					
			AND EQUIPMENT REPORT						X															
		1.18	PURCHASE ORDERS					X																
		01111	SAFETY AND HEALTH REQUIREMENT																					
		1.2	SAFETY AND HEALTH PLAN	X									X											
		01310	PROJECT SCHEDULE																					
		1.1	INITIAL PROJECT SCHEDULE				X							X										
			PRELIMINARY PROJECT SCHEDULE				X							X										
			PERIODIC SCHEDULE UPDATES				X							X										
			QUALIFICATIONS					X					X											
			NARRATIVE REPORT						X				X											
			SCHEDULE REPORT						X				X											
		01440	CONTRACTOR QUALITY CONTROL																					
		3.2.1	QUALITY CONTROL PLAN						X															
		01451	TESTING FOR MECHANICAL																					
			AND ELECTRICAL SYSTEMS																					
		2A	TEST PLAN						X					X										
		01560	ENVIRONMENTAL PROTECTION																					
			PROJECT SITE																					
		1.3	PRECONSTRUCTION SURVEY	X										X										
			ENVIRONMENTAL PROTECTION PLA	X										X										
			EROSION CONTROL PLAN	X										X										
		01700	AS-BUILT RECORD DRAWINGS																					
			AND SHOP DRAWINGS																					
		1.2.4	AS-BUILT MARK-UPS		X								X											
		1.3	AS-BUILT SHOP DRAWINGS		X								X											
		02050	DEMOLITION																					
		1.3	WORK PLAN					X					X											
		02230	CLEARING AND GRUBBING																					
		1.2	MTRLS OTHER SALABLE TIME									X		X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTIO

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		02221	EXCAVATION FOR BUILDINGS																					
		1.3	TEST REPORTS						X				X											
		02225	EARTHWORK FOR ROADWAY																					
		1.5	EARTHWORK					X					X											
		1.5	TESTING						X				X											
		1.5	TESTING							X				X										
		1.5	EARTHWORK									X	X											
		02233	GRADED, CRUSHED BASE																					
		1.2	SAMPLING AND TESTING						X				X											
		2243	DRAINAGE LAYER																					
		1.4	SAMPLING/TESTING						X				X											
		1.4	MATERIAL APPROVAL						X					X										
		1.4	EVALUATION						X					X										
		2285	SOIL TREATMENT FOR SUB																					
		1.1	QUALIFICATION	X									X											
		1.1	PESTICIDES			X							X											
		1.1	PESTICIDES								X		X											
		02316	EXCAVATION, TRENCHING																					
		1.4	FIELD DENSITY TESTS						X				X											
		1.4	TEST BACKFILL MAT.						X				X											
		02511	CONCRETE SIDEWALKS AND																					
		1.4	FIELD QUALITY CONTROL						X				X											
		1.4	CONCRETE									X	X											
		02551	BITUMINOUS PAVEMENT																					
		1.3	BITUMINOUS PAVE.					X					X											
		1.3	JOB MIX FORMULA									X		X										
		02580	PAVEMENT MARKINGS																					
		1.3	EQUIPMENT LISTS	X										X										
		1.3	MIXING, THINNING & APPLICATION			X							X											
		1.3	MATERIAL TESTS						X				X											
		1.3	VOLATILE ORGANIC COMPOUNDS							X				X										
		02620	SUBDRAINAGE SYSTEM																					

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTIO

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		1.2	FILTER FABRIC							X				X										
		1.2	PIPE FOR SUBDRAINS							X				X										
		02660	WATER DISTR.																					
		1.5	INSTALLATION			X							X											
		1.5	WASTE WATER DISPOSAL					X						X										
		1.5	SATISFACTORY INSTALL.					X					X											
		1.5	DISINFECTION						X					X										
		1.5	MANUFACT. REPRESENTATIVE							X			X											
		1.5	INSTALLATION							X			X											
		1.5	METERS							X			X											
		2685	GAS DISTRIBUTION SYSTEM																					
		1.3	PIPE, FITTINGS & ASSOCIATED MA		X								X											
		1.3	EQUIPMENT AND SCHEDULES				X						X											
		1.3	SPARE PARTS				X						X											
		1.3	NOTIFICATION				X							X										
		1.3	WELDING STEEL PIPING					X						X										
		1.3	JOINTING POLYETHELENE AND FIE					X						X										
		1.3	CONNECTION AND ABANDONMENT					X						X										
		1.3	UTILITY WORK							X				X										
		1.3	TRAINING							X			X											
		1.3	GAS DISTRIBUTION SYSTEM									X	X											
		02720	STORM DRAINAGE SYSTEM																					
		1.3	PIPELINE TESTING							X			X											
		1.3	HYDROSTATIC TEST							X			X											
		1.3	DENSITY							X			X											
		1.3	FRAME AND COVER							X			X											
		02730	SANITARY SEWERS																					
		1.4	CEMENT							X			X											
		1.4	OIL RESISTANT MAT.							X				X										
		02732	FORCE MAINS																					
		1.2	HYDROSTATIC TEST						X					X										
		02754	CONCRETE PAVEMENTS FOR																					
		1.6	EQUIPMENT	X									X											
		1.6	PAVING				X						X											
		1.6	MIXTURE PROPORTION					X						X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTIO

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		02935	TURF																					
		1.2	MANUFACTURER LITERAT.	X									X											
		1.2	DELIVERY					X					X											
		1.2	MAINTENANCE REPORT					X					X											
		1.2	TURF ESTABLISHMENT					X					X											
		1.2	SEED							X			X											
		1.2	SOD							X			X											
		1.2	FERTILIZER							X			X											
		1.2	LIMESTONE							X			X											

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		03200	CONCRETE REINFORCEMENT																					
		1.2	REINFORCEMENT SYSTEM		X									X										
		1.2	REINFORCING STEEL							X			X											
		03250	EXPANSION JOINTS, CONTRACTION																					
			JOINTS AND WATERSTOPS																					
		1.2	PREFORMED EXPANSION JOINT																					
			FILLER	X									X											
		1.2	SEALANT	X		X				X			X											
		1.2	WATERSTOPS	X		X				X			X											
		03300	CAST-IN-PLACE STRUCTURAL																					
			CONCRETE																					
		1.4	MIXTURE PROPORTIONS					X						X										
		1.4	TESTING AND INSPECTION						X				X											
		1.4	QUALIFICATIONS							X				X										
		04200	MASONRY																					
		1.2	CLAY/SHALE BRICK	X										X										
		1.2	CONCRETE MASONRY UNITS	X										X										
		1.2	INSULATION	X										X										
		1.2	MASONRY WORK		X									X										
		1.2	COLD WEATHER INSTALLATION					X					X											
		1.2	COLD WEATHER CONST. PROCEDURE					X					X											
		1.2	EFFLORESCENCE TEST						X					X										
		1.2	MORTAR FIELD TESTS						X					X										
		1.2	GROUT FIELD TESTS						X					X										
		1.2	PRISM TESTS						X					X										
		1.2	MASONRY CEMENT						X					X										
		1.2	FIRE-RATED CMU						X					X										
		1.2	CLAY/SHALE BRICK							X			X											
		1.2	CONCRETE MASONRY UNITS							X			X											
		1.2	CONTROL JT. KEYS							X			X											
		1.2	ANCHORS, TIES, BAR POSITIONERS							X			X											
		1.2	EXPANSION JT. MATERIALS							X			X											
		1.2	JOINT REINFORCEMENT							X			X											
		1.2	REINFORCING STEEL							X			X											
		1.2	MASONRY CEMENT							X			X											
		1.2	MORTAR COLORING							X			X											
		1.2	INSULATION							X			X											
		1.2	PRECAST CONCRETE ITEMS							X			X											
		1.2	MORTAR ADMIXTURES							X			X											
		1.2	GROUT ADMIXTURES							X			X											
		1.2	CONCRETE MASONRY UNITS								X			X										
		1.2	CLAY/SHALE BRICK								X			X										
		1.2	ANCHORS, TIES, BAR POSITIONERS								X			X										
		1.2	EXPANSION JOINT MATERIAL								X			X										
		1.2	JOINT REINFORCEMENT								X			X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		1.2	INSULATION								X			X										
		1.2	MOCK-UP PANEL								X			X										
		05055	WELDING, STRUCTURAL																					
		1.4	WELDING PROCEDURE																					
			QUALIFICATIONS					X					X											
		1.4	WELDER, WELDING OPERATOR																					
			AND TACKER QUALIFICATIONS					X					X											
		1.4	INSPECTOR QUALIFICATIONS					X					X											
		1.4	QUALITY CONTROL									X	X											
		05061	ULTRASONIC INSPECTION OF																					
			WELDMENTS																					
		1.4	ULTRASONIC INSPECTION					X				X	X											
		05120	STRUCTURAL STEEL																					
		1.3	STRUCTURAL STEEL SYSTEM		X									X										
		1.3	STRUCTURAL CONNECTIONS		X									X										
		1.3	ERECTION PLAN										X											
		1.3	MILL TEST REPORTS							X			X											
		1.3	WELDER QUALIFICATIONS							X			X											
		1.3	FABRICATION							X			X											
		05210	STEEL JOISTS																					
		1.2	STEEL JOISTS		X									X										
		1.2	STEEL JOISTS							X			X											
		05300	STEEL DECKING																					
		1.2	DECK UNITS	X									X											
		1.2	DECK UNITS		X									X										
		1.2	ACCESSORIES		X									X										
		1.2	ATTACHMENTS		X									X										
		1.2	HOLES AND OPENINGS		X									X										
		1.2	DECK UNITS							X			X											
		1.2	ATTACHMENTS							X			X											
		1.2	ATTACHMENTS					X					X											
		05400	COLD FORMED MTL FRAMING																					
		1.6A	WALL SYSTEM COMPONENTS		X									X										
		1.6B	WALL SYSTEM COMPONENTS							X				X										
		1.6C	WALL SYSTEM COMPONENTS	X										X										
		05500	MISCELLANEOUS METALS																					
		1.2	MISCELLANEOUS METAL ITEMS		X									X										
		06200	FINISH CARPENTRY																					
		1.5A	SYSTEM COMPONENTS		X									X										
		1.5B	HARDWARE			X							X											

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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		07160	BITUMINOUS DAMPROOFING																					
		1.4A	PRIMER	X										X										
		1.4A	BITUMEN PRODUCTS	X										X										
		1.4A	MASTIC	X										X										
		1.4B	COMPONENT SYSTEM			X							X											
		07191	VAPOR RETARDERS																					
		1.7B	VAPOR RETARDER MATERIAL	X										X										
		1.7C	COMPONENT SYSTEM			X							X											
		07212	BOARD INSULATION																					
		1.5A	BOARD INSULATION	X										X										
		1.5B	BOARD INSULATION			X							X											
		1.5C	BOARD INSULATION							X				X										
		1.5D	BOARD INSULATION								X			X										
		07213	BATT INSULATION																					
		1.5A	BATT INSULATION	X										X										
		1.5B	BATT INSULATION							X				X										
		07270	FIRESTOPPING																					
		1.2	FIRESTOPPING		X									X										
			FIRESTOPPING							X				X										
		07416	SEAM METAL ROOF SYSTEM																					
		1.7A	SEAM METAL ROOF SYSTEM						X					X										
		1.7B	SEAM METAL ROOF SYSTEM									X		X										
		1.7C	SEAM METAL ROOF SYSTEM		X									X										
		1.7D	ROOF SYSTEM INSTALLER							X			X											
		1.7E	UL 580						X				X											
		1.7F.1	PANEL SHEET THICKNESS							X			X											
		1.7F.2	PANEL SHEET QUALITY							X			X											
		1.7F.3	MILL CERTIFICATION							X			X											
		1.7G.1	ROOF SYSTEM ACCESSORIES								X			X										
		1.7G.2	ROOF PANELS								X			X										
		1.7G.3	FASTENERS								X			X										
		1.7G.4	INSULATION								X			X										
		1.7G.5	GASKETS/INSULATING COMPOUND								X		X											
		1.7G.6	SEALANTS								X		X											
		1.7G.7	CONCEALED ANCHOR CLIPS								X			X										
		1.7G.8	EPDM RUBBER BOOTS								X		X											
		1.7G.9	GUTTER/DOWNSPOUTS								X			X										
		1.8A	MOCK-UP PANEL								X			X										
		07465	PREFORMED METAL SIDING																					
		1.6A	SYSTEM COMPONENTS		X									X										
		1.6B	WALL PANELS								X			X										
		07620	SHEET METAL FLASHING/TRIM																					

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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		1.5A	FLASHING MATERIALS		X									X										
		1.5B	FLASHING MATERIALS								X			X										
		07900	JOINT SEALERS																					
		1.4A	SEALANTS	X										X										
		1.4B	SEALANTS								X			X										
		1.4C	SEALANTS			X							X											
		08111	STANDARD STEEL DOORS																					
		1.4A	STEEL DOORS		X									X										
		1.4B	STEEL DOORS	X										X										
		1.4C	STEEL DOORS			X							X											
		1.4D	STEEL DOORS							X			X											
		08112	STANDARD STEEL FRAMES																					
		1.4A	STEEL FRAMES		X									X										
		1.4B	STEEL FRAMES	X										X										
		1.4C	STEEL FRAMES								X			X										
		1.4D	STEEL FRAMES			X							X											
		1.4E	STEEL FRAMES							X			X											
		08211	FLUSH WOOD DOORS																					
		1.4A	WOOD DOORS		X									X										
		1.4B	WOOD DOORS	X										X										
		1.4C	WOOD DOORS								X			X										
		1.4D	WOOD DOORS			X							X											
		08318	SECURITY VAULT DOOR																					
		1.4B	SECURITY VAULT DOOR	X										X										
		1.4C	SECURITY VAULT DOOR							X				X										
		1.4D	SECURITY VAULT DOOR		X									X										
		08331	OVERHEAD COILING DOORS																					
		1.6A	OVERHEAD COILING DOOR	X										X										
		1.6B	OVERHEAD COILING DOOR		X									X										
		1.6C	OVERHEAD COILING DOOR								X			X										
		1.6D	OVERHEAD COILING DOOR			X							X											
		08342	STEEL SLIDING HANGAR DOOR																					
		1.3.1	HANGAR DOORS		X									X										
		1.3.2	HANGAR DOORS	X										X										
		1.3.3	HANGAR DOORS									X	X											
		08410	MINUM ENTRANCES AND STOREFR																					
		1.8A	ALUMINUM ENTRANCES		X									X										
		1.8B	ALUMINUM ENTRANCES	X										X										
		1.8C	ALUMINUM ENTRANCES								X			X										
		1.8D	ALUMINUM ENTRANCES							X			X											

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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		08520	ALUMINUM WINDOWS																					
		1.6A	WINDOWS/COMPONENTS		X									X										
		1.6B	WINDOWS/COMPONENTS	X										X										
		1.6C	WINDOWS							X			X											
		1.6D	WINDOWS/COMPONENTS						X					X										
		08710	DOOR HARDWARE																					
		1.5A	DOOR HARDWARE		X									X										
		1.5B	DOOR HARDWARE	X										X										
		1.5C	DOOR HARDWARE								X			X										
		08800	GLAZING																					
		1.5A	GLASS/GLAZING	X										X										
		1.5B	GLAZING/GLAZING COMPOUNDS	X										X										
		1.5C	GLAZING								X			X										
		1.6B	GLAZING PRODUCTS							X			X											
		1.6C	GLAZING MANUFACTURER							X			X											
		08840	TRANSLUCENT WALL PANELS																					
		1.2	TRANSLUCENT WALL PANELS	X										X										
		1.2	ALUMINUM FRAMING SYSTEM	X										X										
		1.2	RANSLUCENT WALL PANEL SYSTE			X							X											
		1.2	RANSLUCENT WALL PANEL SYSTE							X			X											
		1.2	RANSLUCENT WALL PANEL SYSTE		X									X										
		1.2	RANSLUCENT WALL PANEL SYSTE								X			X										
		09111	METAL STUD FRAMING SYSTEM																					
		1.5A	METAL STUD FRAMING SYSTEM		X									X										
		1.5B	METAL STUD FRAMING SYSTEM	X										X										
		1.5C	METAL STUD FRAMING SYSTEM			X							X											
		09260	GYPSUM BOARD SYSTEMS																					
		1.5A	GYPSUM BOARD SYSTEMS		X									X										
		1.5B	GYPSUM BOARD SYSTEMS	X										X										
		09360	FLOOR TILE																					
		1.4A	FLOOR TILE		X									X										
		1.4B	FLOOR TILE	X										X										
		1.4C	FLOOR TILE								X			X										
		1.4D	FLOOR TILE							X			X											
		09307	WALL TILE																					
		1.4A	WALL TILE		X									X										
		1.4B	WALL TILE	X										X										
		1.4C	WALL TILE								X			X										
		1.4D	WALL TILE							X			X											
		9511	SUSPENDED ACOUSTICAL CEILING																					
		1.5A	SUSP. ACOUSTICAL CEILINGS		X									X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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		1.5B	SUSP. ACOUSTICAL CEILINGS	X										X										
		1.5C	SUSP. ACOUSTICAL CEILINGS								X			X										
		1.5D	SUSP. ACOUSTICAL CEILINGS			X							X											
		9650	RESILIENT FLOORING																					
		1.4A	RESILIENT FLOORING		X									X										
		1.4B	RESILIENT FLOORING	X										X										
		1.4C	RESILIENT FLOORING								X			X										
		1.4D	RESILIENT FLOORING			X							X											
		09690	CARPET TILE																					
		1.4A	CARPET TILE		X									X										
		1.4B	CARPET TILE	X										X										
		1.4C	CARPET TILE								X			X										
		1.4D	CARPET TILE			X							X											
		09706	NDUSTRIAL FLUID-APPLIED FLOO																					
		1.2	FLUID-APPLIED FLOOR	X										X										
		1.2	FLUID-APPLIED FLOOR		X									X										
		1.2	FLUID-APPLIED FLOOR						X					X										
		1.2	FLUID-APPLIED FLOOR							X			X											
		1.2	FLUID APPLIED FLOOR								X			X										
		09900	PAINTING																					
		1.5A	PAINT	X										X										
		1.5B	PAINT								X			X										
		1.5C	PAINT			X							X											
		10105	VISUAL DISPLAY BOARDS																					
		1.4A	VISUAL DISPLAY BOARDS		X									X										
		1.4B	VISUAL DISPLAY BOARDS	X										X										
		1.4C	VISUAL DISPLAY BOARDS								X			X										
		10160	METAL TOILET COMPARTMENTS																					
		1.4A	METAL TOILET COMPARTMENTS		X									X										
		1.4B	METAL TOILET COMPARTMENTS	X										X										
		1.4C	METAL TOILET COMPARTMENTS								X			X										
		1.4D	METAL TOILET COMPARTMENTS			X							X											
		10211	FIXED METAL WALL LOUVERS																					
		1.5A	FIXED METAL WALL LOUVERS		X									X										
		1.5B	FIXED METAL WALL LOUVERS	X										X										
		1.5C	FIXED METAL WALL LOUVERS								X			X										
		1.5D	FIXED METAL WALL LOUVERS										X											
		10260	WALL AND CORNERT PROTECTION																					
		1.2	CORNER GUARDS	X										X										
		1.2	CORNER GUARDS		X									X										
		1.2	CORNER GUARDS							X			X											

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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		1.2	CORNER GUARDS								X			X										
		10350	FLAGPOLES																					
		1.6A	FLAGPOLES		X									X										
		1.6B	FLAGPOLES	X										X										
		1.6C	FLAGPOLES								X			X										
		10440	INTERIOR SIGNAGE																					
		1.3	INTERIOR SIGNAGE	X										X										
		1.3	INTERIOR SIGNAGE		X									X										
		1.3	INTERIOR SIGNAGE								X			X										
		10508	METAL WARDROBE LOCKERS																					
		1.4A	METAL WARDROBE LOCKERS	X										X										
		1.4B	METAL WARDROBE LOCKERS		X									X										
		1.4C	METAL WARDROBE LOCKERS								X			X										
		10522	XTINGUISHERS, CABINETS/ACCES																					
		1.4A	FEC'S/ACCESSORIES		X									X										
		1.4B	FEC'S/ACCESSORIES	X										X										
		1.4C	FEC'S/ACCESSORIES			X							X											
		1.4D	FEC'S/ACCESSORIES							X			X											
		10605	WIRE MESH PARTITIONS																					
		1.4A	WIRE MESH PARTITIONS		X									X										
		1.4B	WIRE MESH PARTITIONS	X										X										
		1.4C	WIRE MESH PARTITIONS								X			X										
		1.4D	WIRE MESH PARTITIONS			X							X											
		10800	TOILET AND BATH ACCESSORIES																					
		1.4A	TOILET/BATH ACCESSORIES	X										X										
		1.4B	TOILET/BATH ACCESSORIES								X			X										
		1.4C	TOILET/BATH ACCESSORIES			X							X											
		11134	PROJECTION SCREENS(MANUAL)																					
		1.4A	PROJECTION SCREENS	X										X										
		1.4B	PROJECTION SCREENS		X									X										
		11165	DOCK BUMPERS																					
		1.3A	DOCK BUMPERS	X										X										
		1.3B	DOCK BUMPERS			X							X											
		11311	EL PLATE GRAVITY OIL-WATER SEP																					
		1.3.1A	SEPARATOR		X									X										
		1.3.1B	ACCESSORY EQUIPMENT		X									X										
		1.3.2A	SEPARATOR	X										X										
		1.3.3A	SEPARATOR SYSTEM			X							X											
		1.3.4A	SHOP HYDROSTATIC TEST						X				X											
		1.3.5A	INSPECTIONTESTS						X				X											

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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		1.3.5B	FIELD HYDROSTATIC TEST						X				X											
		1.3.5C	PREOPERATIONAL TEST						X				X											
		1.3.5D	IN-SERVICE TEST						X				X											
		1.3.6A	PARATOR CORROSION PROTECTI							X			X											
		1.3.7A	SEPARATOR SYSTEM									X		X										
		1.3.7B	ACCESSORY EQUIPMENT									X		X										
		13080	CTION FOR MECHANICAL/ELECTRI																					
		1.3	BRIDGE CRANES/BRACING	X										X										
		1.3	LIGHT FIXTURES	X										X										
		1.3	MISCELLANEOUS EQUIPMENT	X										X										
		1.3	BRACING/COUPLING		X									X										
		1.3	FLEXIBLE COUPLINGS		X									X										
		1.3	VIBRATION ISOLATION DEVICES		X									X										
		1.3	BRIDGE CRANES		X									X										
		1.3	LIGHT FIXTURES		X									X										
		1.3	MISCELLANEOUS EQUIPMENT		X									X										
		1.3	FLEXIBLE BALL JOINTS							X			X											
		13120	ANDARD METAL BUILDING SYSTE																					
		1.4	DESIGN ANALYSIS	X										X										
		1.4	METAL BUILDING SYSTEMS		X									X										
		1.4	MFR QUALIFICATIONS					X					X											
		1.4	METAL BUILDING SYSTEMS							X			X											
		1.4	INSULATION							X			X											
		14630	OVERHEAD ELECTRIC CRANES																					
		1.2	OVERHEAD CRANE SYSTEM	X										X										
		1.2	SPARE PARTS	X									X											
		1.2	OVERHEAD CRANE SYSTEM		X									X										
		1.2	FRAMED INSTRUCTIONS			X								X										
		1.2	ACCEPTANCE TESTING						X				X											
		1.2	HOOKS									X	X											
		1.2	OVERHEAD CRANE SYSTEM			X								X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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		15010	BASIC MECHANICAL REQUIREMEN																					
		1.7B	SHOP DRAWINGS	X	X		X	X		X				X										
		1.7C	MAINTENANCE MANUALS	X	X	X	X							X										
		1.11	COORDINATION DRAWINGS		X									X										
		1.12	RECORD DOCUMENTS		X									X										
		15121	PIPING EXPANSION COMP.																					
		1.4B	PRODUCT DATA	X			X							X										
		1.4C	WELDER'S CERTIFICATE							X			X											
		1.4D	SELECTION CALCULATIONS	X										X										
		1.4E	INSTRUCTIONS			X								X										
		15140	SUPPORTS AND ANCHORS																					
		1.3B	SHOP DRAWINGS		X									X										
		1.3C	PRODUCT DATA	X										X										
		1.3D	DESIGN DATA	X										X										
		1.3E	INSTRUCTIONS			X								X										
		1.3F	WELDER'S CERTIFICATES							X			X											
		1.3G	PIPE HANGER SCHEDULE				X							X										
		15170	ELECTRIC MOTORS																					
		1.3B	PRODUCT DATA	X										X										
		1.3C	TEST REPORTS						X				X											
		1.3D	INSTALLATION INSTRUCTIONS			X			X					X										
		15190	MECHANICAL IDENTIFICATION																					
		1.3B	SYMBOL LISTS		X									X										
		1.3C	VALVE SCHEDULE				X							X										
		1.3D	PRODUCT DATA	X										X										
		1.3E	INSTALLATION INSTRUCTIONS			X								X										
		15245	VIBRATION ISOLATION																					
		1.4B	SHOP DRAWINGS		X									X										
		1.4C	PRODUCT DATA	X										X										
		1.4D	INSTALLATION INSTRUCTIONS			X								X										
		1.4E	CERTIFICATES							X			X											
		1.4F	MAINTENANCE DATA	X	X	X								X										
		15260	PIPING INSULATION																					
		1.3B	PRODUCT DATA	X										X										
		1.3C	MANF. CERTIFICATES							X			X											
		1.3D	TEST REPORTS						X				X											
		1.3E	INSTALLATION ISTRUCTIONS			X								X										
		15280	EQUIPMENT INSULATION																					
		1.3B	PRODUCT DATA	X										X										
		1.3C	MATERIAL CERTIFICATES							X			X											
		1.3D	TEST REPORTS						X				X											

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
				DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	INFORMATION ONLY	GOVERNMENT APPROVED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE	SUBMIT TO GOVERN-MENT	CODE	DATE	
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		1.3E	INSTALLATION INSTRUCTIONS			X								X										
		15290	DUCTWORK INSULATION																					
		1.3A	PRODUCT DATA	X										X										
		1.3B	MATERIAL CERTIFICATES							X			X											
		1.3C	TEST REPORTS						X				X											
		1.3D	INSTALLATION INSTRUCTIONS			X								X										
		15410	PLUMBING PIPING																					
		1.3A	PRODUCT DATA	X	X									X										
		15430	PLUMBING SPECIALTIES																					
		1.3A	SHO DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		15440	PLUMBING FIXTURES																					
		1.3A	PRODUCT DATA	X										X										
		1.3B	INSTALLATION INSTRUCTIONS			X								X										
		15450	PLUMBING EQUIPMENT																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		15481	COMPRESSED AIR SYSTEM																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	TEST REPORTS						X				X											
		1.3D	INSTALLATION INSTRUCTIONS			X								X										
		15510	HYDRONIC PIPING																					
		1.4A	PRODUCT DATA	X	X									X										
		1.4B	WELDERS CERTIFICATE							X			X											
		1.4C	INSTALLATION INSTRUCTIONS			X								X										
		15515	HYDRONIC SPECIALTIES																					
		1.3A	PRODUCT DATA	X	X									X										
		1.3B	INSPECTION CERTIFICATE							X			X											
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		15540	HVAC PUMPS																					
		1.4A	PRODUCT DATA	X										X										
		1.4B	MANF. INSTRUCTIONS			X							X											
		1.4C	MILLWRIGHT'S CERTIFICATE							X			X											
		15545	CHEMICAL WATER TREATMENT																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		1.3D	FIELD REPORTS						X				X											
		1.3E	CERTIFICATE							X			X											
		15558	FINNED WATER TUBE BOILERS																					
		1.3A	PRODUCT DATA	X										X										
		1.3B	SHOP DRAWINGS		X									X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		1.3D	FIELD REPORTS						X				X											
		1.3E	FACTORY TEST REPORTS						X					X										
		1.3F	WELDING PROCEDURES							X			X											
		1.3G	WIRING DIAGRAMS		X									X										
		15575	BRECHINGS AND STACKS																					
		1.5A	SHOP DRAWINGS		X									X										
		1.5B	PRODUCT DATA	X										X										
		1.5C	INSTALLATION INSTRUCTIONS			X								X										
		15575	BREECHINGS & CHIMNEYS																					
		1.6B	PRODUCT DATA	X										X										
		1.6A	SHOP DRAWINGS		X									X										
		1.6C	INSTALLATION INSTRUCTIONS			X							X											
		15624	FORCED AIR FURNACES																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		15681	PACKAGED WATER CHILLERS																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	CERTIFICATION							X				X										
		1.3D	INSTALLATION INSTRUCTIONS			X								X										
		15790	AIR COILS																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		1.3D	CERTIFICATE							X				X										
		15835	TERMINAL HEAT TRANSFER UNITS																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	SCHEDULES				X							X										
		1.3E	INSTALLATION INSTRUCTIONS			X								X										
		15855	AIR HANDLING UNITS																					
		1.4A	SHOP DRAWINGS		X									X										
		1.4B	PRODUCT DATA	X										X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
				DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	INFORMATIONONLY	GOVERNMENTAPPROVED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE	SUBMIT TO GOVERN-MENT	CODE	DATE	
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		1.4C	INSTALLATION INSTRUCTIONS			X								X										
		15860	CENTRIFUGAL FANS																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		15865	AXIAL FANS																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		15885	AIR CLEANING COILS																					
		1.4B	SHOP DRAWINGS		X									X										
		1.4C	PRODUCT DATA	X										X										
		1.4D	INSTALLATION INSTRUCTIONS			X								X										
		15890	DUCTWORK																					
		1.4A	PRODUCT DATA	X										X										
		1.4B	TEST REPORTS						X				X											
		15910	DUCTWORK ACCESSORIES																					
		1.3A	SHOP DRAWINGS		X									X										
		1.3B	PRODUCT DATA	X										X										
		1.3C	INSTALLATION INSTRUCTIONS			X								X										
		15940	AIR OUTLETS AND INLETS																					
		1.3A	PRODUCT DATA	X										X										
		15890	DUCTWORK																					
		1.6B	PRODUCT DATA	X										X										
		1.6A	SHOP DRAWINGS		X									X										
		1.6D	INSTALLATION INSTRUCTIONS			X							X											
		1.6C	TEST REPORTS						X					X										
		15951	DDC FOR HVAC																					
		1.3	EQUIPMENT DATA	X										X										
		1.3	SYSTEM DESCRIPTION						X					X										
		1.3	SOFTWARE DESCRIPTION						X					X										
		1.3	TRAINING	X			X							X										
		1.3	DATA ENTRY FORMS	X										X										
		1.3	SYSTEM DRAWINGS		X									X										
		1.3	DAMPER SCHEDULES				X							X										
		1.3	COMMISSIONING PROCEDURES	X										X										
		1.3	COMMISSIONING REPORT						X					X										
		1.3	FUNCTIONAL MANUAL			X								X										
		1.3	HARDWARE MANUAL			X								X										
		1.3	SOFTWARE MANUAL			X								X										
		1.3	OPERATOR'S MANUAL			X								X										

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL: DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	CLASSIFICATION: INFORMATIONAL	CLASSIFICATION: GOVERNMENT APPROVED	REVIEWER	CONTRACTOR SCHEDULE DATES: SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CONTRACTOR ACTION: CODE	DATE	SUBMIT TO GOVERN-MENT	GOVERNMENT ACTION: CODE	DATE	REMARKS
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		1.3	MAINTENANCE MANUAL			X								X										
		15980	INSTRUMENTATION																					
		1.3A	PRODUCT DATA	X										X										
		1.3B	PRODUCT CERTIFICATES							X			X											
		1.3C	MAINTENANCE DATA	X										X										
		1.3D	INSTALLATION INSTRUCTIONS			X								X										
		15990	TAB																					
		1.3A	AGENCY					X						X										
		1.3B	FIELD REPORTS						X					X										
		1.3C	DATA REPORTS						X					X										
		1.3D	DRAFT REPORTS						X					X										
		1.3E	FINAL REPORTS						X					X										
		1.3F	TEST REPORTS						X					X										
		1.3G	CALIBRATION REPORTS						X					X										
		16010	GENERAL PROVISIONS																					
		1.7A	WIRE	X										X										
		1.7A	CONDUIT	X										X										
		1.7A	EQUIPMENT	X										X										
		1.7A	DEVICES	X										X										
		16111	CONDUIT																					
		1.4A	CONDUIT	X										X										
		1.4A	CONDUIT BODY	X										X										
		1.4A	CONDUIT FITTINGS	X										X										
		1.4A	ATTACHMENT DEVICES	X										X										
		16117	MANHOLES																					
		1.5A	MATERIAL INFORMATION	X										X										
		1.5B	MATERIAL INFORMATION		X									X										
		1.5C	MANHOLE ACCESSORIES	X										X										
		1.5D	INSTALLATION			X							X											
		16123	BLDG WIRE & CABLE																					
		1.4A	WIRE AND CABLE	X										X										
		1.4A	WIRING CONNECTORS	X										X										
		1.4A	HEAT SHRINK MATERIAL	X										X										
		1.4A	INSULATING TAPE	X										X										
		1.4A	WIRE PULLING LUBRICANT	X										X										
		1.4B	MEGGER TEST						X				X											
		1.4C	INSTALLATION			X							X											
		16130	BOXES																					
		1.4A	OUTLETS	X										X										
		1.4C	BOXES	X										X										
		16140	WIRING DEVICES																					

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		1.4A	SWITCHES	X										X										
		1.4A	DIMMERS	X										X										
		1.4A	RECEPTACLES	X										X										
		1.4A	PHOTOCELL	X										X										
		1.4B	INSTALLATION			X							X											
		16160	CABINETS, ENCLOSURES																					
		1.4A	CABINETS/ENCLOSURES	X										X										
		1.4B	GENERAL INSTRUCTIONS	X										X										
		16170	GROUNDING AND BONDING																					
		1.6A	ROD ELECTRODES	X										X										
		1.6A	MECH CONNECTIONS	X										X										
		1.6A	EXOTHERMIC CONNECTIONS	X										X										
		1.6A	GROUNDING WELL	X										X										
		1.6B	RESISTANCE TESTS						X				X											
		1.6C	GENERAL INSTRUCTIONS			X							X											
		16180	EQUIPMENT WIRING SYSTEMS																					
		1.6A	CONTROL WIRING	X										X										
		16190	SUPPORTING DEVICES																					
		1.4A	SUPPORTING DEVICES	X										X										
		1.4B	GENERAL INSTRUCTIONS			X							X											
		16195	ELECTRICAL INDENTIFICATION																					
		1.4A	NAMEPLATE	X										X										
		1.4B	GENERAL INSTRUCTIONS			X							X											
		16268	400HZ FREQUENCY CONVERTER																					
		1.3.1/2A	FREQUENCY CONVERTER	X	X									X										
		1.3.1B	NAMEPLATE RATINGS	X										X										
		1.3.2B	WIRING DIAGRAM		X									X										
		1.3.2C	SCHEMATIC DIAGRAM		X									X										
		1.3.2D	OWER/CONTROL EXTERNAL CONI		X									X										
		1.3.3A	WORK PLAN					X						X										
		1.3.3B/C/E	TESTS					X						X										
		16421	UTILITY SERVICE ENTRANCE																					
		1.5A	UTILITY COMPANY		X									X										
		16441	ENCLOSED SWITCHES																					
		1.4A	SWITCH	X										X										
		1.4B	GENERAL INSTRUCTIONS			X							X											
		16461	DRY TYPE TRANSFORMERS																					
		1.4A	TRANSFORMER	X										X										
		1.4B	GENERAL INSTRUCTIONS			X							X											

SUBMITTAL REGISTER
(ER415-1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

TRANS-MITTAL NO.	ITEM NO.	SPECIFICATION & PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
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a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	y.
		16470	PANELBOARDS																					
		1.3A	PANELBOARDS	X										X										
		1.3B	GENERAL INSTRUCTIONS			X							X											
		16477	FUSES																					
		1.4A	ELECTRICAL CHARACTERISTICS	X										X										
		16481	ENCLOSED MOTOR CONTROLLER																					
		1.4A	PRODUCT DATA	X										X										
		1.4B	GENERAL INSTRUCTIONS			X							X											
		16485	CONTACTORS																					
		1.4A	PRODUCT DATA	X										X										
		1.4B	GENERAL INSTRUCTIONS			X							X											
		16510	LIGHTING																					
		1.4A	FIXTURE	X										X										
		1.4A	BALLAST	X										X										
		1.4A	EMERGENCY UNIT	X										X										
		1.4A	EXIT SIGN	X										X										
		1.4A	EMERGENCY (FLUORESCENT)	X										X										
		1.4A	LAMPS	X										X										
		1.4B	GENERAL INSTRUCTIONS			X							X											
		1.4C	GENERAL INSTRUCTIONS			X							X											
		16640	CATHODIC PROTECTION																					
		1.3	CATHODIC PROTECTION	X										X										
		1.3	QUALIFICATION	X										X										
		1.3	EQUIPMENT/MATERIAL		X									X										
		1.3	TEST						X				X											
		16670	LIGHTNING PROTECTION SYSTEMS																					
		1.5A	EQUIPMENT		X									X										
		1.5B	DIMENSIONS/MATERIAL	X										X										
		16721	FIRE ALARM SYSTEMS																					
		1.5A	LAYOUT/WIRING		X									X										
		1.5B	CONTROL PANEL	X										X										
		1.5B	INITIATION DEVICES	X										X										
		1.5B	AUXILIARY DEVICES	X										X										
		1.5B	WIRING	X										X										
		1.5C	INSTALLATION		X								X											
		1.5D	FIRE DEPT. REVIEW	X										X										
		1.5E	FIRE DEPT. COMMENTS	X										X										
		16726	VAULT INTRUSION DETECTION																					
		1.4D	CONTROL PANEL	X										X										
		1.4D	INITIATING DEVICES	X										X										
		1.4D	SIGNALING DEVICES	X										X										

SUBMITTAL REGISTER (ER415-1-10)																								CONTRACT NO.
TITLE AND LOCATION															CONTRACTOR									SPECIFICATION SECTION
				TYPE OF SUBMITTAL									CLASSI-FICATION			CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		
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		1.4D	AUXILIARY DEVICES	X										X										
		1.4E	WIRING	X										X										
		16741	INTERIOR TELEPHONE, ETC.																					
		1.5A	CABLE/PATCH CORDS	X										X										
		1.5A	CONNECTOR BLOCKS	X										X										
		1.5A	PATCH PANELS	X										X										
		1.5A	MODULAR JACKS	X										X										
		1.5A	WALL PLATES	X										X										
		1.5A	J-HOOK SYSTEM	X										X										

SECTION 01310

PROJECT SCHEDULE

03/98

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-07 Schedules

Initial Project Schedule; GA. Preliminary Project Schedule; GA. Periodic Schedule Updates; GA.

Two copies of the schedules showing codes, values, categories, numbers, items, etc., as required.

SD-08 Statements

Qualifications; FIO.

Documentation showing qualifications of personnel preparing schedule reports.

SD-09 Reports

Narrative Report; FIO. Schedule Reports; FIO.

Three copies of the reports showing numbers, descriptions, dates, float, starts, finishes, durations, sequences, etc., as required.

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports. This person shall have previously created and reviewed computerized schedules. Qualifications of this individual shall be submitted to the Contracting Officer for review with the Preliminary Project Schedule submission.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project should also contribute in developing and maintaining an accurate Project Schedule. The approved

Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.1.1 Scheduling Data Format

Scheduling data shall be in SDEF. Scheduling software, capable of producing an SDEF file (standard data exchange format), shall electronically transfer activity data into the Resident Management System (RMS) Contractor Quality Control Modules. RMS requirements are further described in 01440.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel shall result in an inability of the Contracting Officer to evaluate Contractor progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, then the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in either the Precedence Diagram Method (PDM) or the Arrow Diagram Method (ADM).

3.3.2 Level of Detail Required

With the exception of the initial and preliminary schedule submission, the Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

3.3.2.1 Activity Durations

Contractor submissions shall be required to follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods. A rule of thumb, that the Contractor

should use, is that less than 2 percent of all non-procurement activities' Original Durations shall be greater than 20 days.

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing.

3.3.2.3 Government Activities

Government and other agencies activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and notice to proceed for phasing requirements.

3.3.2.4 NOT USED

3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.6 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.7 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number.

3.3.2.8 Bid Item

Should the contract consist of separate bid or Contract Line Item Numbers (CLINs) all activities shall be identified in the project schedule by the Bid Item or CLIN to which the activity belongs. An activity shall not contain work in more than one bid item or CLIN.

3.3.2.9 Phase of Work

Should the contract consist of distinct or separate phases of work, all activities shall be identified in the project schedule by the phases of work in which the activity occurs. Activities shall not be allowed to contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

3.3.2.10 Category of Work

All Activities on the critical path shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited to, to the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.3.2.11 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from notice-to-proceed to the contract completion date.

3.3.3.1 Project Start Date

For PDMs, the schedule shall start no earlier than the date that the Notice to Proceed (NTP) was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have: a "ES" constraint, a constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. For PDMs, the Contractor shall include as the last activity in the project schedule an activity call "End Project". The "End Project" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted at every project schedule update period to assist the Contracting Officer to evaluate the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.4.1 Start Phase

For distinct or separate phases of work, the Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have: a "ES" constraint, a constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

For distinct or separate phases of work, the Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

3.3.4.3 Phase X

For distinct or separate phases of work, the Contractor shall include a hammock type activity for each project phase called "Phase X" where "X:" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in progress or completed activity and insure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without predecessors being completed (Out-of-Sequence Progress) shall be allowed only by the case-by-case approval of the Contracting Officer. The Contracting Officer may direct that changes in schedule logic be made to correct any or all out-of-sequence work.

3.3.7 Extended Non-Work Periods

Designation of Holidays to account for non-work periods of over 5 days shall not be allowed. Non-work periods of over 5 days shall be identified by addition of activities that represent the delays. Modifications to the logic of the project schedule shall be made to link those activities that may have been impacted by the delays to the newly added delay activities.

3.3.8 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after Notice to Proceed is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after Notice to Proceed.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after Notice to Proceed. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer or to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative, is necessary for verifying the contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall submit, with the Initial Project Schedule, a coding scheme that shall be used throughout the project for all activity codes contained in the schedule. The coding scheme submitted shall list the values for each activity code category and translate those values into project specific designations. For example, a Responsibility Code Value, "ELE", may be identified as "Electrical Subcontractor." Activity code values shall represent the same information throughout the duration of the contract. Once approved with the Initial Project Schedule submission, changes to the activity coding scheme must be approved by the Contracting Officer.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the initial submission, and every periodic project schedule update throughout the life of the project:

3.5.1 Data Disks

Two sets of data disks containing the project schedule shall be provided.

3.5.1.1 File Medium

Required data shall be submitted on 3.5" disks, formatted to hold 1.44 MB of data, under the MS-DOS 5.0 operating system.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Initial, Update, or Change), full contract number, project name, project location, Contractor's name data

date, name and telephone number or person responsible for the schedule, and the operating system and version version used to format the disk.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will insure that the names of the files submitted are unique. the Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 3 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in-progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number for PDMs or "I-NODE" AND "J-NODE" for ADMs and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

3.5.4.3 Total Float Report

A list of all activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the Notice to Proceed until the most recent Monthly Progress Meeting. This

report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: Activity Number for PDMs or "i-node" and "j-node" for ADMs, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), Earnings to Date.

3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission, and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity or event number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly on-site meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor will describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost to Date shall be subject to the approval of the Contracting Officer. The following minimum set of items which the Contractor shall address, on an activity by activity basis, during each progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed activities.

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations must be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment shall be based on earnings for each in-progress or completed activity. Payment for individual activities shall not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to Notice to Proceed on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities are those delays beyond the Contractors control such as strikes and unusual weather. Also included are delays encountered due to submittals, Government Activities, deliveries or work stoppage which makes re-planning the work necessary, and when the schedule does not represent the actual prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, he shall furnish such justification, project schedule data and supporting evidence as the Contracting Officer may deem necessary for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension, shall be based upon the project schedule updates in effect for the time period in question and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, shall not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under two weeks based upon the most recent schedule update at the time of the Notice to Proceed or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any request for time extension for over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until the Contractor submits revisions, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, then the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor will continue to update their schedule with the Contracting Officer's revisions until a mutual agreement in the revisions may be made. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

--End of Section - -

SECTION 01415

METRIC MEASUREMENTS

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 380	(1993) Practice for Use of the International System of Units (SI)
ASTM E 621	(1994) Practice for Use of Metric (SI) Units in Building Design and Construction

1.2 GENERAL

This project includes metric units of measurements. The metric units used are the International System of Units (SI) developed and maintained by the General Conference on Weights and Measures (CGPM); the name International System of Units and the international abbreviation SI were adopted by the 11th CGPM in 1960. A number of circumstances require that both metric SI units and English inch-pound (I-P) units be included in a section of the specifications. When both metric and I-P measurements are included, the section may contain measurements for products that are manufactured to I-P dimensions and then expressed in mathematically converted metric value (soft metric) or, it may contain measurements for products that are manufactured to an industry recognized rounded metric (hard metric) dimensions but are allowed to be substituted by I-P products to comply with the law. Dual measurements are also included to indicate industry and/or Government standards, test values or other controlling factors, such as the code requirements where I-P values are needed for clarity or to trace back to the referenced standards, test values or codes.

1.3 USE OF MEASUREMENTS

Measurements shall be either in SI or I-P units as indicated, except for soft metric measurements or as otherwise authorized. The Contractor shall be responsible for all associated labor and materials when authorized to substitute one system of units for another and for the final assembly and performance of the specified work and/or products.

1.3.1 Hard Metric

A hard metric measurement is indicated by an SI value with no expressed correlation to an I-P value, i.e., where an SI value is not an exact mathematical conversion of an I-P value, such as the use of 100 mm in lieu of 4 inches. Hard metric measurements are often used for field data such as distance from one point to another or distance above the floor. Products are considered to be hard metric when they are manufactured to metric dimensions or have an industry recognized metric designation.

1.3.2 Soft Metric

a. A soft metric measurement is indicated by an SI value which is a mathematical conversion of the I-P value shown in parentheses (e.g. 38.1 mm (1-1/2 inches)). Soft metric measurements are used for measurements pertaining to products, test values, and other situations where the I-P units are the standard for manufacture, verification, or other controlling factor. The I-P value shall govern while the metric measurement is provided for information.

b. A soft metric measurement is also indicated for products that are manufactured in industry designated metric dimensions but are required by law to allow substitute I-P products. These measurements are indicated by a manufacturing hard metric product dimension followed by the substitute I-P equivalent value in parentheses (e.g., 190 x 190 x 390 mm (7-5/8 x 7-5/8 x 15-5/8 inches)).

1.3.3 Neutral

A neutral measurement is indicated by an identifier which has no expressed relation to either an SI or an I-P value (e.g., American Wire Gage (AWG) which indicates thickness but in itself is neither SI nor I-P).

1.4 COORDINATION

Discrepancies, such as mismatches or product unavailability, arising from use of both metric and non-metric measurements and discrepancies between the measurements in the specifications and the measurements in the drawings shall be brought to the attention of the Contracting Officer for resolution.

1.5 RELATIONSHIP TO SUBMITTALS

Submittals for Government approval or for information only shall cover the SI or I-P products actually being furnished for the project. The Contractor shall submit the required drawings and calculations in the same units used in the contract documents describing the product or requirement unless otherwise instructed or approved. The Contractor shall use ASTM E 380 and ASTM E 621 as the basis for establishing metric measurements required to be used in submittals.

-- End of Section --

SECTION 01440
CONTRACTOR QUALITY CONTROL

03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	(1994a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(1993b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause entitled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The Contractor's highest ranking manager on site shall be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. This individual shall be the person with the responsibility for the overall management of the project including quality and production.

3.2 QUALITY CONTROL PLAN

3.2.1 General

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause entitled "Inspection of Construction." The plan shall identify personnel,

procedures, control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters will also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01300 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same

trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

j. For each definable feature of work, the preparatory and initial controls planned for that feature shall be identified in the form of a list. The list shall be in the same order as the technical specification section. The planned preparatory and initial meetings will be reviewed and agreed upon by both the Government and Contractor at the coordination meeting, although revisions may be required.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 14 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 General

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure contract compliance. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, each with a minimum of 3 years construction experience on construction similar to this contract or a construction person with a minimum of 5 years in related work. This CQC System Manager shall be on the site at all times during construction and will be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate will be the same as for the designated CQC System Manager.

3.4.3 CQC Personnel

The Contractor shall maintain sufficient staff to ensure adequate coverage of all work. Any additional staff shall be at no additional expense to the Government.

3.4.3.1 Specialized CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager. These specialized personnel may be employees of the prime or subcontractor and shall be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan; and shall have the necessary education and/or experience.

3.4.4 Additional Requirement

In addition to the above experience and education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors" no later than 60 days after the Contractors receipt of the Notice To Proceed. This course is periodically offered by the Corps of Engineers. Specific times and locations are available from the Contracting Officer.

3.4.5 Interview

All CQC personnel are subject to interview prior to acceptance by the Contracting Officer.

3.4.6 Organizational Changes

The Contractor shall maintain his CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS

Submittals shall be made as specified in Section 01300 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 48 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon or conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing

laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, will be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility will be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of the cost of the recheck to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 On-Site Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, f.o.b., at an address to be identified for each type of test. Coordination for each specific test, exact delivery

location, and dates will be made through the Contracting Officer at the Area Office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished the Contractor shall notify the Government that the facility is ready for the Government "Pre-Final" inspection.

3.8.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected and so notify the Government so that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-Final" inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, his superintendent or other primary management person and the contracting Officer's representative will be in attendance at this inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice will be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and must include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause entitled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals reviewed, with contract reference, by whom, and action taken.

g. Off-site surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.9.1 Deficiency Tracking Log

The Contractor shall establish and maintain, a daily formal deficiency tracking log that shall be kept at the job site. The log shall include, as a minimum, the following:

a. Contract title and number.

b. Date reported.

c. Reported by.

d. Deficient work (By an identification number).

e. Type of Deficiency (Construction = C, Safety = A).

f. Description of corrective action(s).

g. Date corrected.

h. Verified by.

3.9.2 IMPLEMENTATION OF GOVERNMENT RESIDENT MANAGEMENT SYSTEM (RMS)

The Contractor shall utilize the government furnished computer program, Resident Management System (RMS), for generating the Contractor's Daily Quality Control Reports and in submitting other project information as described below. Government personnel from the administering office will load the program onto a computer designated by the Contractor and will also provide the basic funding/bid item data for the project. Government personnel will be available to conduct an on-site informal training session of up to 8 hours on the setup and use of this system. The minimum system requirements necessary to run the program are:

PC - IBM compatible (486 of better)

16 MB of RAM

30 MB of free hard disk space

3.5" high density floppy drive

HP LaserJet Series III or later printer

MS-DOS version 5.0 or higher - RMS will run under Windows

The Contractor shall use the program to enter the following: Prime Contractor staffing and subcontractor data; definable features of work (items requiring a preparatory inspection) and pay activities to include Activity ID number, value, duration, start and finish dates, with subcontractor and bid item reference for each; required Quality Control Tests, planned User Schooling and Installed property, each tied to specific paragraphs and activities; submittal information to include specification section, description, expected days required for procurement and days of float for material need by dates, all of which shall be tied to the appropriate activity; and the system will be use to prepare proposed cumulative progress earnings. The sum of all activity values shall equal the contract amount, and all bid items shall be separately identified in accordance with the bid schedule and total the contract amount. This information shall be entered into the program and submitted to the administering office on high density 3.5" diskette(s) under the MD-DOS version 5.0 or higher operating system. This information shall be updated as required and submitted to the administering office on a monthly basis or otherwise required.

During the course of the contract, the Contractor will receive from the government various Quality Assurance comments which reflect existing deficiencies - items needing the attention of the Contractor. The Contractor shall acknowledge receipt of these comments/deficiencies by specific number reference (QA-##) on the Daily CQC Report and shall record in RMS any corrective action taken.

Contractor Daily Quality Control Reports (QCR) shown in Section 01440, Attachment 4 give general format of this report, actual QCR shall be prepared in RMS.

The Contractor Quality Control module of RMS offers the contractor the ability to produce payment applications, record and print daily QC logs, monitor and track essential quality control activities and track submittals. The contractor can also generate the ENG Form 4025 with RMS.

3.10 SAMPLE FORMS - ATTACHMENTS

Sample forms enclosed at the end of this section include:

a. Attachment No. 1 - Sample of a Listing for the Definable Features of Construction Work.

b. Attachment No. 2 - Preparatory Phase Checklist.

c. Attachment No. 3 - Initial Phase Checklist.

d. Attachment No. 4 - Construction Quality Control Reports.

e. Attachment No. 5 - Test Report.

f. Attachment No. 6 - Deficiency Tracking Log.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the worksite, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

SECTION 01440 ATTACHMENT NO.1
GUIDE FOR LISTING DEFINABLE FEATURES OF CONSTRUCTION WORK

****** Contractor shall modify this guide to accommodate the project *****

DIVISION 1 - GENERAL REQUIREMENTS

(a) Special Project procedures to include coordination of work, Project meetings, Submittals and Quality Control
(b) Administrative Requirements
(c) Environmental Protection
(d) Historic Preservation
(e) Job Conditions

DIVISION 2 - SITE WORK

(a) Demolition
(b) Removal and Disposal of Asbestos Materials
(c) Excavation, Trenching and Backfilling for Utilities Systems to include sewer gravity drainage and water lines
(d) Clearing and Grubbing, Backfilling for Buildings
(e) Grading
(f) Fence, Chain-Link
(g) Concrete for sidewalks and Curbs
(h) Drilled Pile Foundation
(i) Bituminous Paving
(j) Underground Sprinkler Systems

DIVISION 3 - CONCRETE

(a) Concrete Materials, Concrete Procedures, Concrete Formwork, Forms, Form Ties and Accessories, Concrete Reinforcement, Concrete Accessories to Include Cast-in-Place Concrete, Specially Placed Concrete, Concrete Finishing, Concrete Curing and Grouting
(b) Concrete Restoration and Cleaning
(c) Precast Concrete
(d) Electrical and Mechanical Inserts
(e) Testing
(f) Approval of Samples

DIVISION 4 - MASONRY

(a) Masonry Procedures, Mortar, Mortar Accessories, Unit Masonry, Cavity Wall Construction to Include Bringing Inner and Outer Wythes Up Simultaneously, Reinforcement, Wall Ties, Flashing, Masonry Restoration and Cleaning
(b) Acceptance of Sample Panel for Cavity Wall Construction
(c) Composite Wall Construction
(d) Acceptance of Sample Panel for Composite Wall Construction
(e) CMU Partition Wall Construction to Include Prepared Openings for Ducts, Fire Dampers, Door Frames, Lintels and Bond Beams
(f) Acceptance of CMU Partition Wall Sample Panel
(g) Insulation and Waterproofing
(h) Testing

ATTACHMENT NO.1 (continued)
DIVISION 5 - METALS

(a) Structural Steel Framing To Include Metal Materials and Methods, Metal Fastening, Metal Joints, Welding, Expansion Control and Miscellaneous Metals
(b) Steel Roof Decking
(c) High Strength Bolts

DIVISION 6 - WOODS AND PLASTICS

(a) Rough Carpentry To Include Framing, Prefabricated Structural Wood, Fasteners and Supports, Roof Sheeting, Siding and Sub-Flooring, Insulation and Flashing (b) Finish Carpentry To Include Wood Treatment, Finish Flooring, Cabinets and Closets

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

(a) Damproofing and Waterproofing
(b) Fireproofing
(c) Insulation, Flashing and Sheet Metal, Roof Accessories, Sealants, Shingles, Roof Tiles and Membrane Roofing (Built-Up and EPDM)

DIVISION 8 - DOORS AND WINDOWS

(a) Metal Doors and Frames, Wood and Plastic Doors, Special Doors, Door Opening Assemblies, Metal Windows, Wood and Plastic Windows, Special Windows, Glazing and Miscellaneous Hardware, Caulking

DIVISION 9 - FINISHES

(a) Ceramic Tile
(b) Gypsum Wallboard To Include Special Framing, Shaft Wall Framing System, Ceiling and Wall Opening
(c) Acoustical Treatment to include Metal Suspension System for Acoustical Tile and Lay-In-Panel Ceiling
(d) Wall Covering
(e) Carpeting
(f) Resilient Flooring
(g) Painting
(h) Furring (Metal)
(i) Plastering

DIVISION 10 - SPECIALTIES

(a) Metal Toilet Partitions
(b) Raised Floor System
(c) Movable Partitions
(d) Wardrobe
(e) Fire Extinguisher Cabinets
(f) Toilet Accessories

ATTACHMENT NO.1 (continued)
DIVISION 11 - EQUIPMENT

(a) Fueling System for Motor Vehicles
(b) Adjustable Loading Ramps
(c) Incinerator, Packaged Controlled Air
(d) Incinerator, Medical Waste, General Purpose, Field Erected
(e) Food Service Equipment
(f) Government Furnished Equipment

DIVISION 12 - FURNISHINGS

(a) Theater Chairs
(b) Blinds
(c) Drapes
(d) Lockers
(e) Training Equipment
(f) Furniture and Accessories
(g) Rugs and Mats
(h) Fabrics

DIVISION 13 - SPECIAL CONSTRUCTION

(a) RF Shielding
(b) Sky Lights
(c) Swimming Pool
(d) Energy Monitoring and Control System (EMCS)
(e) Pre-Engineered Structures
(f) Liquid and Gas Storage Tanks
(g) Vaults

DIVISION 14 - CONVEYING SYSTEMS

(a) Shaft Construction To Include Guides and Guide Rails
(b) Car Assembly
(c) Machine Room Layout
(d) Entrances
(e) Operating and Signal Devices
(f) Fire/Emergency Power Operations
(g) Lighting, Power and Wiring
(h) Elevator Power Unit
(i) Acceptance Testing To Include Communications, Safety, Weights, Emergency and Fire Operations, Dispatch System

DIVISION 15 - MECHANICAL

(a) Insulation to Include:
(1) Pipes
(2) Ducts
(3) Equipment
(4) High Density Inserts, Insulation Protective Shields, Clips or U Bolt Supports for Multiple Pipe Hanger Supports
(5) Perimeter Insulation

ATTACHMENT NO. 1 (continued)

(b) Plumbing Systems
- (1) Waste/Vent Piping To Include: Underground Soil Piping, Above Ground Soil Piping
- (2) Interior Piping Rough-In To Include: Galvanized Black Iron and Copper Including Drains, Fittings, Valves and Piping Supports
- (3) Plumbing Fixtures To Include Flush Valves, Faucets and Accessories
- (4) Cleaning, Balancing and Operational Testing

(c) Heating systems
- (1) Equipment and System Accessories
- (2) Hot Water/Steam Piping Supports
- (3) Fuel Oil/Gas Piping and Supports
- (4) System Testing and Balancing

(d) Air Distribution Systems
- (1) Equipment and Accessories
- (2) Duct Work To Include Galvanized, Aluminum, Flexible and Fiberglass, Supports, Dampers, Louvers, Diffusers, Duct Line Supports and Fire-Dampers

(e) Refrigeration Systems
- (1) Equipment and Accessories
- (2) Chilled Water/Condenser Water Piping and Supports
- (3) Refrigerant Piping and Supports
- (4) System Testing

(f) Automatic Temperature Control Systems
- (1) Equipment and Materials
- (2) Installation of Materials and Equipment
- (3) System Testing

(g) Underground Heat Distribution Systems
- (1) Manholes
- (2) Piping and Supports
- (3) Cathodic Protection

(h) Sprinkler Systems
- (1) Equipment
- (2) Piping and Supports
- (3) Accessories

(i) Water Treatment Systems

(j) Welding - Piping Systems

DIVISION 16 - ELECTRICAL

(a) Exterior Electrical Distribution, Aerial
- (1) Pole Setting
- (2) Placement of Crossarms, Pins, Insulators, Pole Line Hardware and Conductors
- (3) Placement of Fuse Cutouts, Surge Arresters, Reclosers, Potheads, Pole Mounted Transformers to Include Grounding Conductors, Testing and Cable Terminations

(b) Exterior Electrical Distribution, Underground
- (1) Duct Line Excavation, Placement of Ducts and Misc. Materials
- (2) Placement of In Ground Junction or Pull Boxes and Manholes
- (3) Placement of Duct Bank Concrete Encasement
- (4) Transformer Pad Placement
- (5) Mounting of Pad Mounted Transformers

ATTACHMENT NO.1 (continued)

(6) Cable Placement to Include Splicing, Fire-Proofing and Cable Terminations

(7) Grounding Conductors and Testing

(c) Electrical Distribution, Interior

(1) Wiring Methods to Include Conduit Rough-in, Raceway Boxes, Outlet Boxes, Panelboard Cabinets, Placement of Conductors and Conduit Placement Below the Slab for Slab-On-Grade Construction

(2) Wiring Devices, Panelboards, Switch-Boards and Lighting Fixtures

(3) Motors and Transformers

(4) Testing

(d) Fire Detection and Alarm System

(1) Wiring Methods to Include Conduit, Ground Rods, Detectors, Control Panels, Power Supply, Door Holders, Audible Fire Alarm and Annunciator Panel

(2) Testing

---End of Attachment No.1---

SECTION 01440 ATTACHMENT NO.2
PREPARATORY PHASE CHECKLIST

CONTRACTOR'S NAME (Address)

Contract No.:_____ Date Preparatory Held:_____

Title: _____ Spec Section:_____

_____ Drawing No(s):_____

Definable Feature of Work:_____

_____

A. PERSONNEL PRESENT:

Name	Position	Company
1._____	_____	_____
2._____	_____	_____
3._____	_____	_____
4._____	_____	_____
5._____	_____	_____
6._____	_____	_____
7._____	_____	_____
8._____	_____	_____

(List additional personnel on reverse side)

B. DRAWINGS AND SPECS:

I. Has each spec paragraph, contract drawing, and shop drawing been studied? YES _____ NO _____

II. Do all parties have up-to-date drawings and specifications? YES _____ NO_____

C. SHOP DRAWINGS INVOLVED:

Transmittal/Item	Code	Contractor or Gov't Approval
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____

ATTACHMENT NO.2 (continued)

D. MATERIALS:

I. Are all materials on hand? YES _____ NO _____

II. Have all materials been checked for contract compliance against approved shop drawings? YES _____ NO _____

III. Items not on hand or not in accordance with transmittals (if not on hand, check during initial phase):

1. _____

2. _____

3. _____

4. _____

E. TESTS required in accordance with contract requirements:

Test/Paragraph	Frequency
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

F. ACCIDENT PREVENTION: Has Hazard Analysis been completed?
YES _____ NO _____
If yes, attach a copy, if no, explain:

_____

_____

_____

_____

_____

ATTACHMENT NO.2 (continued)

G. EQUIPMENT Requiring Operational Check:

1._____

2._____

3._____

4._____

H. WORKMANSHIP: Have procedures for accomplishing work been reviewed with appropriate people? YES _____ NO _____

I. PREVIOUS WORK: Has all preliminary work been accomplished in accordance with contract requirements and is this feature of work ready to start? YES _____ NO _____

Explain any problems: _____

_____

_____

_____

J. HI-LIGHTING SPECIFIC ITEMS: Hi-light specific items noted during the Preparatory Phase inspection. ie, (Med. Voltage cable shall be hi-pot tested).

K. OTHER COMMENTS: _____

_____

_____

_____

_____
Quality Control Representative
Signature

SECTION 01440 ATTACHMENT NO.3
INITIAL PHASE CHECKLIST

CONTRACTOR'S NAME (Address)

Contract No.:_____ Date Initial Held: _____

Title:_____ Spec Section:_____

Drawing No(s).:_____

Definable Feature of Work:_____

_____

_____

A. PERSONNEL PRESENT:

Name Position Company

1._____

2._____

3._____

4._____

5._____

6._____

B. MATERIALS being used are in strict accordance with the contract plans and specifications? YES _____ NO _____

If not, explain:_____

_____

_____

_____

ATTACHMENT NO.3 (continued)

C. WORKMANSHIP:

I. Procedures and/or work methods witnessed are in strict compliance with the requirement of the contract specifications? YES _____ NO _____

If not, explain: _____

_____

_____

II. Workmanship is acceptable? YES _____ NO _____

State area where improvement is needed: _____

_____

_____

D. SAFETY violations and corrective action taken:_____

_____

_____

E. COMMENTS: _____

_____

_____

_____

_____

_____
Quality Control Representative
Signature

SECTION 01440 ATTACHMENT NO.4
DAILY CONSTRUCTION QUALITY CONTROL REPORT
(Sample of Typical Contractor Daily Quality Control Report)

CONTRACTORS NAME (Address)

Date _____ Report No. _____ Contract No. DAC( ) 65-__-C-_____
Project Name and Location of work: _____

Weather:[Clear] [P.Cloudy] [Cloudy] [Rain: ___ inches] [Temp.____min.____max.]
Other Weather Conditions _____

1. Contractor (C) or Sub-contractor (S), and Area of Responsibility:

a. ( )_____
b. ( )_____
c. ( )_____
d. ( )_____
e. ( )_____

2. Equipment Data. (Indicate items of construction equipment, other than hand tools, at the job site and whether or not used):

_____
_____
_____
_____

3. Work Performed Today (Indicate identity of Contractor and Sub-contractors, location , and description of work:

_____
_____
_____
_____

4. Results of Surveillance: (Include satisfactory work completed, or deficiencies with action to be taken):

a. Preparatory Phase:_____
_____
_____
_____

b. Initial Phase:_____
_____
_____
_____

c. Follow-up Phase:_____
_____
_____
_____

DAILY CONSTRUCTION QUALITY CONTROL REPORT (Continued)

5. Tests performed as required by plans and specifications and the results:

_____
_____
_____

6. Verbal instructions received (List instructions given by Government personnel on construction deficiencies, retesting required, etc. Include the name of Government person, time and place instructions given, and action taken to comply:

_____
_____
_____

7. Job Safety (Include deficiencies and corrective action taken:

_____
_____
_____

8. Equipment Data (Indicate items of construction equipment, other than hand tools, at the job site, and whether or not used):_____

_____
_____
_____

9. Material and equipment items that arrived at the job site. Indicate compliance or non-compliance of these items with approved shop drawings, the contract plans and specifications, and the storage of the item is required prior to the time of installation, indicate how this storage was provided and whether or not it is adequate:_____

_____
_____

10. Remarks (Cover any conflicts in the plans and specifications, instructions, or delays):_____

_____

_____

CONTRACTOR'S VERIFICATION: THE ABOVE REPORT IS COMPLETE AND ALL DATA LISTED IS CORRECT. ALL MATERIALS PROVIDED, EQUIPMENT USED, AND WORKMANSHIP FOR THIS REPORTING PERIOD ARE IN COMPLIANCE WITH THE CONTRACT PLANS AND SPECIFICATIONS EXCEPT AS NOTED ABOVE.

SIGNED

_____ CONTRACTOR'S QC SYSTEM MANAGER

SECTION 01440 ATTACHMENT NO.5
TEST REPORT

CONTRACTOR'S NAME (Address)

STRUCTURE OR BUILDING_____
CONTRACT NO._____

DESCRIPTION OF ITEM, SYSTEM OR PART OF SYSTEM TESTED:_____
_____
_____
_____
_____

DESCRIPTION OF TEST:_____
_____
_____
_____
_____

NAME AND TITLE OF PERSON IN CHARGE OF PERFORMING TESTS FOR CONTRACTOR:

NAME_____

TITLE_____

SIGNATURE_____

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED ITEM, SYSTEM OR PART OF SYSTEM HAS BEEN TESTED AS INDICATED ABOVE AND FOUND TO BE ENTIRELY SATISFACTORY AS REQUIRED IN THE CONTRACT SPECIFICATIONS.

SIGNATURE OF CONTRACTOR QUALITY CONTROL INSPECTOR

_____

DATE_____

REMARKS:_____
_____
_____
_____
_____

SECTION 01440 ATTACHMENT NO. 6
DEFICIENCY TRACKING LOG

_____ Construction Deficiency
_____ Safety Deficiency

Contract No. _____
Project Title _____

Date Reported	Reported By	Deficient Work	Description of Corrective Actions Taken	Date Corrected	Verified By

SECTION 01451

TESTING FOR MECHANICAL AND ELECTRICAL SYSTEMS

1. Applicability:

This section applies to all mechanical and electrical system and all systems using electromagnetically driven equipment, pneumatic or electronic systems; high low voltage electrical distribution systems (except branch panels) and to any system which incorporates this section into other parts of the specification by reference. For purpose of this section a "system" is an entity comprised of a series of closely related interdependent performance of a useful function. System components shall include all software and programming as applicable for the system. Some typical example include:

a. Independently functioning HVAC System.

b. Fire Alarm Systems.

c. Public Address Systems.

d. Sprinkler Systems including alarms.

e. Telephone Systems including cable, splices cables, switching equipment, outlets and instruments.

f. Intrusion Detection System.

g. High Voltage Equipment including cable, splices, switchgear, relays, circuit breakers, fuses, transformers, instrumentation, etc.

h. Low Voltage Switchboard including incoming and outgoing feeders, circuit protection and all accessories.

2. Test Plan:

a. Not later than sixty days after Notice to Proceed, in

accordance with Section "Submittals" and other paragraphs of the technical provisions, the Contract shall submit a list for approval consisting of all systems for which test plans are required. This list will be reviewed by the Government and any systems found to be missing will be required to be added by the Contractor, and appropriate test plans submitted. No work will be permitted on any of the systems until this list is submitted.

b. The Contractor shall develop test plans and schedule operational testing for the systems in the approved list. The testing shall be in accordance with the requirements in the appropriate technical provisions and shall include as a minimum the requirements below. All testing required by applicable codes, standards, utility companies, manufacturers, suppliers, etc. shall be incorporated into the Contractor's test plans. Test plans shall list all equipment required to perform the tests, and any Government support required. It shall be in sufficient detail to permit a step-by-step approach to the test and to demonstrate that the systems operate as intended by the contract documents. It shall describe as a minimum:

1. What system is being tested including a listing of all components to be tested.

2. What individual or organization will perform testing, who will certify the tests, and qualifications of test personnel.

3. A step by step narrative of the testing procedure to by used to demonstrate contract compliance including all governing standards, such as "sequence of controls", "ASTM Standard XXX"; or IEEE Standard XXX", etc.

4. What testing equipment will be utilized.

5. What operator interaction is required.

6. What results are to be expected.

7. Seasonal limitations, if any, including dates(s) of proposed testing.

8. A complete schematic diagram (electrical, pneumatic) showing all components, and block diagram.

9. A checklist shall be developed to be used during the operational test.

c. Test plans shall be submitted for approval for all systems contained on the list submitted per para 2a. above. It is also desirable to submit all test plans as soon as possible so that the progress of the project and corresponding payments will proceed on schedule.

3. Testing Process:

a. Outlined below are a number of events relating to the status of the test plan and testing. The corresponding percentages indicate the maximum percentage of the value of the system which will be permitted to be installed after the successful completion of the corresponding event indicated, for all systems to which this section applies. Events must be completed sequentially. Any work performed in excess of the permitted percentages will be at the Contractor's own risk and will not be paid until the event corresponding to the percentage of system value permitted to be installed is successfully completed:

	EVENT	MAX % OF SYSTEM VALUE PERMITTED TO BE INSTALLED
1.	Contractor has submitted list of system that require test plans to be approved, and system work is ongoing but not test plan submitted.	50

Modular Design System

2.	Test Plan Submitted	65
3.	Test Plan Approved*	80
4.	Success completion of tests including submission of required documents, reports (i.e. balancing reports for all HVAC Systems), Operation and Maintenance Manuals spare parts, and spare data.	100**

* The Government will process the submittal in accordance with the time frames indicated in the specification section "Submittals". If the test plan is disapproved the Government has an additional 30 days to review the resubmittal form the date it receives the resubmittal.

** If a system involves both heating and cooling modes and one mode had been successfully tested this percentage shall be reduced to 90% until the testing is completed.

b. The Contractor may proceed with events as indicated in the above table for each system separately.

4. Operational tests including performance tests shall be conducted for an entire system, not component parts only. Test may be conducted only after an entire system has been completely installed. Contractor shall provide a minimum of 14 days notice to the Contracting Officer of scheduled tests. This notice must include the Contractor's assurance that all installed work previously identified to the Contractor as being unacceptable along with all remaining work associated with the respective system will be complete and acceptable by the date scheduled for the operational test. Failure of the Contractor to have all contract work acceptably complete for this test will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection costs.

5. Outside Consultants:

Modular Design System

a. For each system the Contractor shall obtain the services of an experienced professional who shall certify that the operational test was conducted in accordance with the approved test plan and the results of this test meet all the contract requirements. These individuals must have a minimum of eight years experience in the testing of the particular system being tested and shall also meet qualifications (if any) set forth in other technical sections of the contract specifications.

b. An experienced HVAC controls engineer as specified above shall be enlisted to review all controls submittals for compliance with the project documents, This person shall be available for assistance during all aspects of the controls package installation, troubleshooting, and commissioning stages. Refer to section 15950.

6. When considering the value of a system for payment purposes the following components shall be counted as part of a "system": All electo-magnetically driven equipment; pneumatic or electric control system; gages, dampers, valves, actuators, controllers, pipes, test sensing elements, logic/processors, CPU's, ducts, insulation, wiring, conduit, switchgear, and all other mechanical or electrical components, devices or equipment which are essential to the proper function of the system such as pumps, motors, air-handling units, chillers, cooling towers, etc. Software programs and any refrigerants are also considered "parts" of a system.

7. The requirements contained in this section supplement other testing requirements contained in the contract documents. If a conflict exists between the requirements of this section and other parts of the contract documents, the requirements of this section shall take precedence.

END OF SECTION

SECTION 01500
TEMPORARY CONSTRUCTION FACILITIES

3/98

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, entrance(s), utilities, and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate any supplemental or other staging area.

1.1.2 Identification of Employees

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work to display identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the facility.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1 Payment for Utility Services

The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The contractor shall notify the Contracting Officer, in writing, 5 working days before mobilization of the site so that a utilities contract can be established for the existing building. The Contractor shall carefully conserve any utilities furnished without charge.

1.2.2 Meters and Temporary Connections

The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall provide and maintain all necessary temporary connections, distribution lines, meter bases and meters required to measure the amount of each utility used for the purpose of determining charges. The Contractor shall notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract

can be established. Other utility connections shall be made by the Contractor as directed by the Contracting Officer.

1.2.3 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of $50.00 will be required. The last monthly bills for the Federal fiscal year (01 Oct through 30 Sep of the following year) will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next Federal fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current Federal fiscal year.

1.2.4 Final Meter Reading

Before completion of the project work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, and notify the Contractor of the final amount due, if any. The Contractor shall then remove all the temporary distribution lines, meter base(s), and associated paraphernalia, and restore all disturbed areas to original condition or better prior to final acceptance of the work by the Government.. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

1.2.5 Sanitation

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.6 Telephone

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

1.3 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1 Bulletin Board

Within fifteen days after receipt of the Notice To Proceed, the Contractor shall provide a weatherproof bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract documents, Wage Rate Information poster, and other information required or approved by the Contracting Officer. The bulletin board shall be located at the project site outside of the contractor's trailer in a conspicuous place, easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work under this contract is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

1.3.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be provided at a location designated by the Contracting Officer. The signs shall be erected within 15 days after receipt of the Notice to Proceed. The data required by the safety sign shall be corrected daily, with light

colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed and disposed of by the Contractor.

1.3.2.1 Project Sign

The project sign shall conform to the requirements as indicated on Attachment No.1, attached hereto.

1.3.2.2 Safety Sign

The safety sign shall conform to the requirements as indicated on Attachment No.2, attached hereto. The data required by the sign shall be corrected daily, with light colored metallic or non-metallic numerals. Numerals, including mounting hardware, shall be subject to the approval of the CO.

1.3.2.3 Payment

No separate payment will be made for the sign work covered under this section of the specifications and all costs in connection therewith will be considered as a subsidiary obligation of the Contractor, covered by the contract prices in this contract.

1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flag men, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.4.1 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night. Barricades and other physical protection shall be in accordance with EM 385-1-1.

1.5 CONTRACTOR'S TEMPORARY FACILITIES

1.5.1 Administrative Field Offices and Storage Areas

The Contracting Officer will designate an area within which the Contractor shall be permitted to place administrative or storage trailers for equipment and limited construction materials other than in trailers. The Contractor shall provide and maintain administrative field office facilities within the

construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.5.1.1 Appearance of Trailers

Trailers utilized by the Contractor, whether for the purpose of administrative use or materials storage, shall present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the CO, are not in good repair shall not be allowed on the Post.

1.5.1.2 Equipment

Any item of construction equipment, with the exception of hand tools, which becomes inoperable shall be repaired within five (5) working days or removed from the construction site.

1.5.1.3 Maintenance of Storage Area(s)

It shall be the responsibility of the Contractor to keep all fencing in a state of good repair and proper alignment. Should the Contractor elect to traverse grassed or other areas without paving that are not established roadways, with construction equipment or other vehicles, such grassed or other areas shall be covered with a layer of gravel as necessary to prevent rutting and to prevent the tracking of mud onto paved or established roadways. Gradation of the gravel shall be at the discretion of the Contractor. The Contractor shall be responsible for the cutting of grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers and in areas not accessible to mowers shall be edged or trimmed neatly.

1.5.1.4 Sanitation

It shall be the responsibility of the Contractor to provide and maintain minimum field-type sanitary facilities, approved by the CO, within the construction area. Present Government toilet facilities will not be available to the Contractor's personnel.

1.5.1.5 TELEPHONE

The Contractor shall be responsible for making all arrangements and paying all cost for telephone facilities he may require.

1.5.2 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.6 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored

material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.7 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

SECTION 01560
ENVIRONMENTAL PROTECTION (PROJECT SITE)

03/98

PART 1 GENERAL

1.1 DEFINITIONS

For the purpose of this specification environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, and may affect other species and natural resources of importance to man.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are listed in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.94-SUBPART G	Occupational Health and Environmental Control
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
49 CFR 178	Shipping Container Specifications

CORPS OF ENGINEERS (COE)

EP-1165-2-304	Perspective on Flood Plain Regulations for Flood Plain Management (1976)
ER-1165-2-26	Implementation of Executive Order 11988 on Flood Plain Management (March 1984)
EM 385-1-1	Safety and Health Requirements Manual (September 1996)

VIRGINIA SOIL AND WATER CONSERVATION COMMISSION (VSWCC)

VESCH	Virginia Erosion and Sediment Control Handbook (1992)

VIRGINIA ADMINISTRATIVE CODE

9VAC25-31	Virginia Pollutant Discharge Elimination System
9VAC25-180	(VPDES) General Permit For Storm Water Discharges From Construction Sites

1.3 SUBMITTALS

The contractor shall submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES.

SD-01 Data

Preconstruction Survey; GA

Prior to commencement of work the Contractor shall perform a preconstruction survey of the project site with the Contracting Officer and take photographs showing existing environmental conditions in and adjacent to the site. A brief report of the results of this survey shall be prepared by the contractor and copies furnished to the Contracting Officer. The contractor shall certify that he has read and understands regulations 29 CFR 1910.94-SUBPART G, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 49 CFR 178, EP-1165-2-304, ER-1165-2-26, 9VAC25-31, 9VAC25-180, and VESCH provide proof that he has performed work in accordance with these regulations.

Environmental Protection Plan; GA

The Contractor shall submit for approval within 10 days after Notice to Proceed, and prior to any work on the site, his written Environmental Protection Plan.The Contractor shall meet with the Contracting Officer, to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The plan shall demonstrate compliance with 29 CFR 1910.94-SUBPART G, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 49 CFR 178, EM 385-1-1, EP-1165-2-304, ER-1165-2-26, VR 680-14-19, and VESCH.

Erosion Control Plan; GA

The contractor shall, within 10 days after the Notice to Proceed, submit an Erosion Control Plan in accordance with VESCH and as otherwise specified for approval of the Contracting Officer, showing the Contractor's scheme for controlling erosion and disposing of wastes. The Erosion Control Plan shall include as a minimum the following items indicating adequate measures to:

a. Reduce by the greatest extent practicable the area and duration of exposure of readily erodible soils.

b. Protect the soils by use of temporary vegetation, or seeding and mulch, or by accelerating the establishment of permanent vegetation. Complete and protect segments of work as rapidly as is consistent with construction schedules.

c. Retard the rate of runoff from the construction site and control disposal of runoff.

d. Sprinkle or apply dust suppressors, or otherwise keep dust within tolerable limits on haul roads and at the site.

e. Borrow areas furnished by the contractor shall be at a location where pollution from the operation can be minimized. Locations should be avoided where pollution would be inevitable.

f. Provide temporary measures for the control of erosion in the event construction operations are suspended for any appreciable length of time.

g. Provide protection against discharge of pollutants such as chemicals, fuel, lubricants, or sewage into any stream.

h. Locate sanitary facilities away from streams, wells, or springs.

1.4 GENERAL REQUIREMENTS

1.4.1 General

The work covered by this section consists of furnishing all labor, materials and equipment and performing all work required for the prevention of environmental pollution during and as the result of construction operations under this contract. In the event the measures set forth in other Technical Provisions of these specifications and this Section conflict, the most stringent standard shall apply. The control of environmental pollution requires consideration of air, water, and land.

1.4.2 Provisions

Provide and maintain, during the life of the contract, environmental protection.
Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project.

1.4.3 Compliance

The contractor shall comply with Federal, state, and local regulations pertaining to the environmental pollution control and abatement, including but not limited to water, air, land, and noise pollution. All applicable provisions of the Corps of Engineers Manual, EM 385-1-1, entitled "Safety and Health Requirements Manual" in effect on the date of solicitation, as well as the specific requirements stated elsewhere in the contract specifications shall be strictly observed and enforced.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 NOTIFICATION

The Contracting Officer will notify the contractor in writing of any non-compliance with the foregoing provisions and the action to be taken. The contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the contractor unless it was later determined that the contractor was in compliance.

3.2 SUBCONTRACTORS

Compliance with the provisions of this section by subcontractors will be the responsibility of the contractor.

3.3 PROTECTION OF WATER RESOURCES

The contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumens, calcium chloride, acid construction wastes or other harmful materials. It is the responsibility of the contractor to investigate and comply with all applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams. All work under this contract shall be performed in such a manner that objectionable conditions will not be created in streams through or adjacent to the project areas.

3.4 INDUSTRIAL POLLUTION HAZARDS

Hazardous substances as defined in 40 CFR 261 or as defined by applicable state and local regulations, and dust which poses air pollution hazards shall be controlled as approved to comply with all applicable laws which govern the work.

3.4.1 DUST CONTROL

The contractor shall maintain all work areas free from dust which would contribute to air pollution. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

3.5 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

During the life of this contract the contractor shall maintain all facilities constructed for pollution control under this contract as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.6 MAINTENANCE OF PERMITS

The Contractor shall immediately provide to the Contracting Officer two copies of any modification, revocation or reissuance of any applicable permit required to complete the work. The Contractor shall provide two copies of all correspondence with Federal, State or Local Government offices regarding any applicable permit within 5 days. The Contractor shall notify the Contracting Officer in writing at least 5 days prior to any visit to the site by any Federal, State or Local Government office, other than those scheduled by the Contracting Officer, scheduled to observe compliance with applicable permits provided the Contractor receives at least 5 days notice. Otherwise the Contractor shall immediately provide the Contracting Officer written notice of the date, time, office(s) participating and features to be observed by the most expeditious means available.

-- End of Section --

SECTION 01700
AS-BUILT RECORD DRAWINGS AND SHOP DRAWINGS

03/98

PART 1 GENERAL

1.1 GENERAL

The Contractor shall, upon completion of each facility under this contract, provide the Contracting Officer as-built record contract drawings and as-built reproducible shop drawings.

1.2 AS-BUILT CONTRACT DRAWINGS

1.2.1 Record of Job Progress Changes and Corrections

During the progress of the job, the Contractor shall keep a careful record at the job site of all construction changes and corrections from the layouts and details and conditions shown on the drawings. These as-built contract drawings shall be a record of the construction as installed and completed by the Contractor. They shall include all the information shown on the contract set of drawings, and all deviations, modifications, or changes from those drawings, however minor, which were incorporated in the work, including all additional work not appearing on the contract drawings, and all changes which are made after any final inspection of the contract work. The as-built drawings changes shall be annotated in a single color (RED) and shall indicate in addition to all changes and corrections, the actual location, kinds and sizes of all subsurface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The depth below the surface of each run shall also be recorded at each high and low point.

1.2.2 Additional Work

In the event the Contractor accomplished additional work which changes the as-built conditions of the facility after submission of the final as-built drawings, the Contractor shall furnish revised and/or additional drawings as required to depict final as-built conditions. The requirements for these additional drawings will be the same as for the as-built drawings specified in this paragraph.

1.2.3 Daily Record of As-Built Conditions

The Contractor shall maintain a full-size set of contract drawings for depicting the record of as-built conditions. These as-built drawings shall be maintained in a current condition at all times during the entire contract period and shall be readily available for review by the CO at all times. All changes from the contract plans which are made in the work, or additional information which might be uncovered in the course of construction, shall be recorded on the prints accurately and neatly by means of details and notes using clearly contrasting single colored (RED) pen to permit ready identification of the change to the print. The as-built drawings shall reflect correctly scaled drawings of the construction as actually performed, and include but not be limited to as-built features showing:

a. Complete and accurate scaled drawings of as-built conditions that are changed from the contract drawings.

b. Layout and schematic drawings of electrical circuits, pole lines, and piping, etc.

c. Correct dimensions and details transferred from shop drawings and contract changes.

d. Correction of alignment, cross section, and layout of earthwork, roadways, etc.

e. Actual location of anchors, embedded items, construction and control joints, depth of footings, etc., for concrete and masonry work.

f. Changes in location of equipment and architectural features.

g. Deletion of phrases such as "optional requirement," or "or equal,", etc., with a listing of the specific items of material or equipment provided.

h. Unusual or uncharted obstructions encountered in the contract work area during construction.

i. Location, extent, thickness, and size of stone protection, particularly where it will be covered by water.

j. Actual invert locations and elevations, where different from those shown on the contract drawings, for utility and process pipelines.

k. The Contractor shall complete the AS-BUILT DRAWING CHECKLIST, attached hereto, and submit it with the as-built drawings.

1.2.4 Submittal to the Contracting Officer for Review and Approval

Two sets of the as-built marked-up drawings shall be delivered to the CO, at the time of beneficial occupancy of each structure or facility involved under this contract, for review and approval. This submittal shall include a copy of the AS-BUILT DRAWING CHECKLIST signed by the CQC Manager. If, upon review of the as-built drawings, errors and/or omissions are found, the as-built marked-up prints will be returned to the Contractor for correction. The Contractor shall complete the corrections and return the drawings to the CO upon transfer of the facility.

1.3 AS-BUILT SHOP DRAWINGS

Upon completion of each separate facility or phase of work under this contract, the Contractor shall provide a complete reproducible set of all shop drawings as finally approved and one set of prints. These shop drawings shall show all changes made up to the time the equipment, materials or general construction was completed and accepted. This requirement applies only to those features that are extensions of design (including but not limited to pre-engineered metal buildings and similar), designs provided by the contractor (including but not limited to sprinkler systems and similar), and approved deviations from the contract drawings. Reproducible drawings shall be on Mylar drafting media or approved equal.

1.4 PAYMENT FOR AS-BUILTS CONTRACT/SHOP DRAWINGS

No separate payment shall be made to the Contractor for preparation of either As-Built Contract Drawings or As-Built Shop Drawings. If the Contractor fails to maintain the in-progress as-built contract/shop drawings as required herein, the CO will deduct from the monthly progress payment, an amount representing the estimated monthly cost of maintaining the record drawings, and will continue deduction of the 10% retainage even after 50% completion of the contract. In addition, final payment with respect to separately priced facilities or the contract as a whole, will be withheld until proper as-built contract/shop drawings have been provided to the CO.

AS-BUILT DRAWINGS CHECKLIST

Project	Contract #
Contractor	Date

Check one of the following:

	YES	NO	N/A
1. Revisions to site layout plans indicated.	___	___	___
2. Site Grading Plan:	___	___	___
a. Finish grade change indicated.	___	___	___
b. Manhole location & invert elevations shown correct.	___	___	___
c. Finish floor elevations of building(s) shown correct.	___	___	___
d. Road locations with turn outs, drainage, etc.	___	___	___
3. Exterior utility lines, locations (actual routing), type of material and heat tracing, size & type of valves, drain cocks, air rents, etc., all shown correct for the following:			
a. Gas	___	___	___
b. Water	___	___	___
c. Steam	___	___	___
d. Condensate	___	___	___
e. Sanitary Sewer	___	___	___
f. Electrical Power	___	___	___
g. Communications, Fire alarms, etc.	___	___	___
4. All road layouts & detail revisions noted.	___	___	___
5. Record temporary water, power, or any			

other utility or structural appurtenance
abandoned in place. ___ ___ ___

Check one of the following:	YES	NO	N/A
6. Architectural:			
a. Floor plans dimensional changes noted.	___	___	___
b. Door locations size & swing revisions indicated.	___	___	___
c. Interior finish schedule changes noted.	___	___	___
d. All wall section and detail changes noted.	___	___	___
e. Roof plan drain locations, scuppers, roof mounted equipment and slope shown correct.	___	___	___
f. All Equipment Schedules corrected to reflect actual equipment installed or furnished.	___	___	___
g. Reflected ceiling plan shows actual mechanical and electrical access panels, grill opening locations.	___	___	___
7. Structural:			
a. Footing plan revisions noted. Elevation of bottom of footings and type of material (soil).	___	___	___
b. All schedules for footings columns, beams and girders shown as actually constructed.	___	___	___
c. Concrete equipment pads shown in correct location, size and reinforcement.	___	___	___
d. Floor framing plan dimensions, section cuts, expansion joints, construction joints, and floor openings shown correct.	___	___	___
e. Concrete structural details indicate actual steel reinforcement provided.	___	___	___
f. All miscellaneous structural supports for architectural, mechanical & electrical items shown as erected.	___	___	___

Check one of the following:	YES	NO	N/A
8. Mechanical:			
a. Plumbing layout correct as shown.	___	___	___
b. Riser diagrams correct as shown.	___	___	___
c. Interior roof drain shown in correct locations.	___	___	___
d. Fire sprinkler system installed as shown.	___	___	___

e. Heating and air conditioning layout correct as shown.	___	___	___
f. Equipment connections shown in actual locations.	___	___	___
g. Equipment sizes & data shown on schedules are as installed.	___	___	___
h. Sequence of operations, controls, etc, revised to reflect system installed.	___	___	___
9. Electrical:			
a. Conduit layout for receptacles.	___	___	___
b. All changes to riser and one line diagrams noted.	___	___	___
c. Panel board configuration shown correct.	___	___	___
d. Changes in equipment control circuits.	___	___	___
e. Relocations of telephone outlets (paging outlets) and fire detectors shown on plans.	___	___	___
f. Panel board circuit diagrams & schedules revision noted on drawings.	___	___	___
g. Distribution system changes (wire sizes, type & routing) indicated on drawings.	___	___	___
h. Street lighting layout shown as installed.	___	___	___
i. Switchgear configuration changes reflected on drawings.	___	___	___
Check one of the following:	YES	NO	N/A
10. Cross out such work as "optional requirement", "or equal", etc. and list specifically the items of material provided	___	___	___
11. When catalog cuts, schematic drawings, parts lists, etc. are necessary to supplement marked-up contract drawings, clearly delineate what is actually installed if more than one size or model is illustrated. If more than one size or model is used on the job, indicate locations where each model is used.	___	___	___
12. All executed contract modifications have been incorporated as appropriate.	___	___	___
13. In some cases as-built shop drawings will be required. If required by the contract, the same procedure should be followed for as-built drawings. Note that a complete set of shop drawings are submitted to the user, therefore, shop drawing data must also reflect as-built conditions.	___	___	___

CERTIFICATION OF AS-BUILT CHECKLIST

------	----------
Date	Contractor Quality Control Manager Signature

PART 2 PRODUCTS (This Part Not Used)

PART 3 EXECUTION (THIS PART NOT USED)

-- END OF SECTION --

SECTION 02050

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan; FIO.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will

not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the items being demolished and take immediate action to protect all personnel working in and around the demolition site.

The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.2 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection From the Weather

Salvageable materials and equipment shall be protected from the weather at all times.

1.5.4 Protection of Trees

Trees within the project site which might be damaged during demolition and which are indicated to be left in place shall be protected by a 1.83 m high fence. The fence shall be securely erected a minimum of 1.5 m from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.5 Environmental Protection

The work shall comply with the requirements of Section 01560 ENVIRONMENT PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed to 0.5 meter below grade. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in Section 02316. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes and other hazardous openings shall be filled in accordance with Section 02221.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Items Salvaged for the Government

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

3.4.1.3 NOT USED

3.4.1.4 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off Government property. Combustible material shall be disposed of off the site.

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

-- End of Section --

SECTION 02221

EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEFINITIONS

1.2.1 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557abbreviated hereinafter as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation;

submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Density Tests; FIO. Testing of Backfill Materials; FIO.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials include materials classified in ASTM D 2487 as GW, GP, SW, GC, GM, SP, SC, and SM, and shall be free of trash, debris, roots or other organic matter, or stones larger than 75 mm in any dimension. Satisfactory in situ materials include materials classified in ASTM D 2487 as GW, GP, GC, GM, SW, SP, SC, SM, CL, CH, MH, and ML.

2.1.2 NOT USED

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.4 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 25 when tested in accordance with ASTM D 4318.

2.1.5 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material shall be a uniformly graded washed sand with a maximum particle size of 40 mm and less than 5 percent passing the 0.075 mm size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

2.2 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 37.5 mm and no more than 2 percent by weight shall pass the 4.75 mm size sieve.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

Clearing and grubbing is specified in Section 02230 CLEARING AND GRUBBING.

3.2 TOPSOIL

Topsoil shall be stripped to a depth of 50 millimeters below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified hereinafter, and shall include trenching for utility and foundation drainage systems to a point 1.5 m beyond the building line of each building and structure, excavation for outside grease interceptors, underground fuel tanks, and all work incidental thereto. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.4 DRAINAGE AND DEWATERING

3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.4.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 900 mm of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 0.6 meters below the working level.

3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and

utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving. Shoring plans and installation procedures shall be submitted to the Contracting Officer for approval prior to construction.

3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

3.7 BLASTING

Blasting will not be permitted.

3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated in accordance with EM 385-1-1 to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 150 mm below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted in conformance with paragraph FILLING AND BACKFILLING.

3.9 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained as specified in Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS AND AIRFIELDS.

3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS AND AIRFIELDS.

3.11 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. For pile foundations, the excavation shall be stopped at an elevation of from 150 to 300 mm above the bottom of the footing before driving piles. After pile driving has been completed, the remainder of the excavation shall be completed to the elevations shown. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking or other erosion resulting from ponding or flow of water.

3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. The surface

shall be scarified to a depth of 150 mm before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 150 mm, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 300 mm and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

3.13 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 200 mm in loose thickness, or 150 mm when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade and shall include backfill for outside grease interceptors and underground tanks. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 600 mm above sewer lines and 300 mm above other utility lines shall be free from stones larger than 25.4 mm in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 100 mm in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
Fill, embankment, and backfill		
Under structures, building slabs,		

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
Nonfrost susceptible materials		95
Subgrade		
Under building slabs, steps, and paved areas, top 300 mm	90	95
Under sidewalks, top 150 mm	85	90

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompaction over underground utilities and heating lines shall be by hand tamping.

3.14 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937 shall be used only for soft, fine-grained, cohesive soils. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

3.14.1 In-Place Densities

3.14.1.1 In-Place Density of Subgrades

One test per 300 square meters or fraction thereof.

3.14.1.2 In-Place Density of Fills and Backfills

One test per 300 square meters or fraction thereof of each lift for fill or

backfill areas compacted by other than hand or hand-operated machines. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 3 meters in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 100 square meters, or one test for each 30 linear meter of long narrow fills 90 meters or more in length.

3.14.2 Moisture Content

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216.

3.14.3 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 380 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

3.15 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16 GRADING

Areas within 1.5 m outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 SPREADING TOPSOIL

Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 50 mm by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 1.46 kN/m to 2.34 kN/m of roller. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

3.18 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

SECTION 02225

EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1140	(1992) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 NOT USED

1.3 NOT USED

1.4 DEFINITIONS

1.4.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by, ASTM D 2487 as GW, GP, SW, GC, GM, SP, SC, SM, CL, CH, MH, and ML. Satisfactory materials for grading shall be free from roots and other organic matter, trash, debris, and frozen materials and stones larger than 150 mm in any dimension.

1.4.2 NOT USED

1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.4.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557abbreviated as a percent of laboratory maximum density.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-08 Statements

Earthwork; FIO.

Procedure and location for disposal of unused satisfactory material. Blasting plan when blasting is permitted. Proposed source of borrow material.

SD-09 Reports

Testing; FIO.

Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests.

SD-13 Certificates

Testing; GA.

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

SD-18 Records

Earthwork; FIO.

Notification of encountering rock in the project. Advance notice on the

opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

1.6 SUBSURFACE DATA

Subsurface soil boring logs are shown in Section 01055 SOIL BORING DATA. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.7 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.8 BLASTING

Blasting will not be permitted.

1.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 100 millimeters. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.2 EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph

FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 1 meter from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown or from other approved sources, either private or within the limits of the project site, selected by the Contractor. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02720 STORM-DRAINAGE SYSTEM; and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 100 mm; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

3.8 EMBANKMENTS

3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm. The material shall be placed in successive horizontal layers of loose material not more than 200 millimeters in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as

necessary and scarified or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.9 SUBGRADE PREPARATION

3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 150 mm below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways and airfields shall not show deviations greater than 9.5 millimeter when tested with a 3 meter straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finish subgrade shall not vary more than 15 mm from the established grade and cross section.

3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, each layer of the embankment shall be compacted to at least 90 percent of laboratory maximum density.

3.9.2.1 NOT USED

3.9.2.2 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown.

3.9.2.3 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 90 percentage laboratory maximum density for the full depth of the shoulder.

3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the

Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.11 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 30 mm of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

3.12 NOT USED

3.13 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. The first inspection be at the expense of the Government. Cost incurred for any subsequent inspections required because of failure of the first inspection will be charged to the Contractor. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, and ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.13.1 Fill and Backfill Material Gradation

One test per 300 cubic meters stockpiled or in-place source material.

Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422, and ASTM D 1140.

3.13.2 In-Place Densities

a. One test per 500 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 300 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 30 linear meters, or fraction thereof, of each lift of embankment or backfill for roads and airfields.

3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

a. One check test per lift for each 1000 square meters, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 600 square meters, of fill or backfill areas compacted by hand-operated machines.

c. One check test per lift for each 60 linear meters, or fraction thereof, of embankment or backfill for roads and airfields.

3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 380 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the

finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

-- End of Section --

SECTION 02230

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 mm in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-18 Records

Materials Other Than Salable Timber; GA.

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 40 mm or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 40 mm in diameter shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 455 mm below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 DISPOSAL OF MATERIALS

3.4.1 NOT USED

3.4.2 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --

SECTION 02285

SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Qualifications; FIO.

Qualifications of the pesticide applicator.

SD-06 Instructions

Pesticides; FIO.

Manufacturer's label and Material Safety Data Sheet (MSDS) for pesticides proposed for use.

SD-14 Samples

Pesticides; FIO.

Samples of the pesticides used in this work, upon request.

1.2 QUALIFICATIONS OF PESTICIDE APPLICATORS

The pesticide applicator's principal business shall be pest control and the pesticide applicator shall be State certified in the U.S. Environmental Protection Agency (EPA) pesticide applicator category which includes structural pest control, and certified in the State.

1.3 DELIVERY, STORAGE, AND HANDLING

Pesticides shall be delivered to the project site in sealed and labeled containers in good condition as supplied by the manufacturer or formulator. Pesticides shall be stored, handled, and used in accordance with manufacturer's labels. Labels shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended.

1.4 SAFETY REQUIREMENTS

The Contractor shall formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Water for formulating shall only come from sites designated by the Contracting Officer, and filling hose shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Pesticides and related materials shall be kept under lock and key when unattended. Proper protective clothing and equipment

shall be worn and used during all phases of termiticide application.

1.5 WARRANTY

The Contractor shall provide a 5-year written warranty against infestations or reinfestations by subterranean termites of the buildings or building additions constructed under this contract. Warranty shall include annual inspections of the buildings. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim, the Contractor shall:

a. Re-treat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;

b. Repair damage caused by termite infestation; and

c. Reinspect the building approximately 180 days after the retreatment.

PART 2 PRODUCTS

2.1 MATERIALS

Termiticides shall be currently registered by the EPA.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

At the time of application, the soil moisture content shall be sufficiently low to allow uniform distribution of the treatment solution throughout the soil. Applications shall not be made during or immediately following heavy rains or when conditions may cause runoff and create an environmental hazard.

3.2 APPLICATION

3.2.1 Treatment of New Structures

The Contractor shall establish complete and unbroken vertical and/or horizontal (as necessary) soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Application shall not be made to areas intended for use as a plenum air space. Surface treatments shall not be made for areas to serve as crawl spaces. Termiticide shall be applied as a coarse spray and provide uniform distribution unto the soil surface. Treatment shall be applied prior to placement of a vapor barrier or waterproof membrane and at least 12 hours prior to concrete placement. Where treated soil or fill material is not to be covered with a vapor barrier or waterproof membrane, adequate precautions shall be taken to prevent its disturbance. Soil or fill material disturbed after treatment shall be re-treated as specified above before placement of slabs or other covering structures. Treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures shall be coordinated with final grading and planting operations so as to avoid disturbance of the treated barriers. Manufacturer's warnings and precautions shall be observed in the handling and use of such materials. Care shall be taken to prevent these chemicals from entering water supply systems, potable water supplies, or aquifers; and that they do not endanger plants or animals. The Contracting

Officer shall be notified at least 48 hours prior to beginning of treatment and formulating, mixing, and application shall be performed in the presence of the Contracting Officer's representative.

3.2.2 NOT USED

3.2.3 Rates and Methods of Application

Rates and methods of application shall be in accordance with the manufacturer's instructions on the pesticide label. Maximum application or dosage rates shall be used. If the pesticide contains less than the amount of active ingredient specified on the label, work shall be repeated with pesticides conforming to this specification.

3.3 DISPOSAL

The Contractor shall dispose of residual pesticides and containers off Government property in accordance with label instructions and EPA criteria.

-- End of Section --

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 NOT USED

1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Density Tests; FIO. Testing of Backfill Materials; FIO.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall consist of any material classified by ASTM D 2487 as GC, GM, SP, SC, SM, CL, CH, MH, ML, GW, GP, and SW.

2.1.2 NOT USED

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 NOT USED

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 75 millimeters in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a 0.075 mm mesh sieve and no less than 95 percent by weight passing the 25 mm sieve. The maximum allowable aggregate size shall be 75 millimeters, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material free from rocks 75 millimeters or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 50 millimeters in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 152 mm wide with minimum thickness of 0.102 mm. Tape shall have a minimum strength of 12.1 MPa lengthwise and 10.3 MPa crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 1 meter deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Earth excavation shall include removal and disposal of all material. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 600 mm. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed and in accordance with EM 385-1-1. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 1.5 meters high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 1.2 meters high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm plus pipe outside diameter (O.D.) for pipes of less than 600 mm inside diameter and shall not exceed 900 mm plus pipe outside diameter for sizes larger than 600 mm inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of

redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 75 millimeters or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 100 millimeters below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.2 Stockpiles

Stockpiles of satisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the

stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm loose thickness for compaction by hand operated machine compactors, and 200 mm loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 0.6 meters above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

3.2.1.3 Bedding and Initial Backfill

Bedding shall be select granular material, maximum size per the pipe manufacturer. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS control. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not

specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 NOT USED

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 1 meter from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.3 NOT USED

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 600 mm from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 450 millimeters below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

3.4.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 1557. A minimum of one particle size analysis

and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 30 meters of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic meters of material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 0.6 meters above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 900 mm shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

-- End of Section --

SECTION 02511

CONCRETE SIDEWALKS AND CURBS AND GUTTERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1990a) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	(1990) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616	(1990) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617	(1990) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 171	(1991) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 173	(1978) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(1991) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete

Paving and Structural Construction

ASTM D 3405	(1994) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

CORPS OF ENGINEERS (COE)

COE CRD-C 527	(1988) Standard Specification for Joint Sealants, Cold-Applied, Non-Jet-Fuel-Resistant, for Rigid and Flexible Pavements

1.2 NOT USED

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Quality Control; FIO.

Copies of all test reports within 24 hours of completion of the test.

SD-18 Records

Concrete; FIO.

Copies of certified delivery tickets for all concrete used in the construction.

1.5 WEATHER LIMITATIONS

1.5.1 Placing During Cold Weather

Concrete placement shall be discontinued when the air temperature reaches 5 degrees C and is falling. Placement may begin when the air temperature reaches 2 degrees C and is rising. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 2 degrees C, placement shall be approved in writing. Approval shall be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees C for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.5.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 30 degrees C except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 35 degrees C.

1.6 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.6.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.6.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CONCRETE FOR BUILDING CONSTRUCTION except as otherwise specified. Concrete shall have a minimum compressive strength of 24 MPa at 28 days. Maximum size of aggregate shall be 37.5 mm.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 50 millimeters where determined in accordance with ASTM C 143.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615, ASTM A 616, or ASTM A 617. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 9.5 mm (3/8 inch) thick, unless otherwise indicated.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to COE CRD-C 527.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

2.6 FORM WORK

Form work shall be designed and constructed to insure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 50 mm nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 3 m. Radius bends may be formed with 19 mm boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 3 m (10 feet) with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 3 m or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 38 mm (1-1/2 inch) benders, for the full height of the curb, cleated together.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be carefully set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of three stakes per form placed at intervals not to exceed 1.2 meters. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to insure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 3 mm in any 3 m long section. After forms are set, grade and alignment shall be checked with a 3.05 m straightedge. Forms shall have a transverse slope of 20 millimeters per meter with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer of such thickness that when consolidated and finished the sidewalks will be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a wood float, bull float, or darby, edged and broom finished.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished carefully with an edger having a radius of 3 mm. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 7.9 mm from the testing edge of a 3.05 m straightedge. Permissible deficiency in section thickness will be up to 6.4 mm.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators.

3.4.2 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 13 mm. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.3 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 6.4 mm from the testing edge of a 3.05 m straightedge. Permissible deficiency in section thickness will be up to 6.4 mm.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 1.5 m on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 3 m or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 3 mm blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Expansion Joints

Expansion joints shall be formed with 9.5 mm joint filler strips. Joint filler shall be placed with top edge 6 mm below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 3 mm, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be

carefully cleaned and filled with joint sealer.

The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 1.5 m nor greater than 4.5 m in length. Contraction joints shall be constructed by means of 3 mm thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 9.5 mm in width shall be provided at intervals not exceeding 10 meters. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit.

Expansion joints and the top 1-inch depth of curb and gutter contraction-joints shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with two or more layers of burlap. Mats shall overlap each other at least 150 mm. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 300 mm when a continuous sheet is not used. The curing medium shall not be less than 450 mm wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 5 square meters per liter for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the

jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 190 cubic meters of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31 by an approved testing laboratory. Each strength test result shall be the average of two test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 4 MPa.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector.

If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 190 cubic meters, or fraction thereof, of concrete placed during each shift. Additional tests will be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noticed along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 6 mm. All pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 02551

BITUMINOUS PAVING FOR ROADS, STREETS AND OPEN STORAGE AREAS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29	(1991a) Unit Weight and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 183	(1995) Sampling and the Amount of Testing of Hydraulic Cement
ASTM D 5	(1994) Penetration of Bituminous Materials
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1856	(1995a) Recovery of Asphalt from Solution by Abson Method
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 3381	(1992) Viscosity-Graded Asphalt Cement for Use in Pavement Construction

ASTM D 3515	(1989) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 4791	(1995) Flat or Elongated Particles in Coarse Aggregate

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT	Road and Bridge Specifications (Latest Edition)

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Bituminous Pavement; FIO.

Copies of test results.

SD-18 Records

Job Mix Formula; GA.

Submit JMF 90 days prior to preparing and placing bituminous mixture.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General

The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output.

1.4.2 Mixing Plants

The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). The plant shall have a minimum capacity of 100 metric tons per hour. Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

1.4.3 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 3.66 m straightedge for each bituminous paver. Straightedge shall be

made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

1.5 WEATHER LIMITATIONS

Unless otherwise directed, bituminous courses shall not be constructed when temperature of the surface of the existing pavement or base course is below 5 degrees C.

1.6 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 60 degrees C.

1.7 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surface of bituminous courses, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

1.7.1 Plan Grade

The grade of the completed surface shall not deviate more than 15.2 mm from the plan grade.

1.7.2 Surface Smoothness

When a 3.66 m straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 6.4 mm from the straightedge.

1.8 GRADE CONTROL

Lines and grades shall be established and maintained by means of line and grade stakes placed at site of work in accordance with the Special Contract Requirements. Elevations of bench marks used by the Contractor for controlling pavement operations at the site of work will be shown on the drawings. Finished pavement elevations shall be established and controlled at the site of work by the Contractor in accordance with bench mark elevations.

1.9 SAMPLING AND TESTING

1.9.1 Aggregates

1.9.1.1 General

Samples of aggregates shall be furnished by the Contractor for approval of aggregate sources and stockpiles prior to the start of production and at times during production of the bituminous mixtures. Times and points of sampling will be designated by the Contracting Officer. Samples will be the basis of approval of specific sources or stockpiles of aggregates for aggregate requirements. Unless otherwise directed, ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler. All tests necessary to determine compliance with requirements specified herein will be made by the Contractor.

1.9.1.2 Sources

Sources of aggregates shall be selected well in advance of the time the materials are required in the work. If a previously developed source is selected, evidence shall be submitted 90 days before starting production, indicating that the central-plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least five years under similar climatic and traffic conditions. The Contracting Officer will make such tests and other investigations as necessary to determine whether aggregates meeting requirements specified herein can be produced from proposed sources. If a sample of material from a new source fails to meet specification requirements, the material represented by the sample shall be replaced, and the cost of testing the replaced sample will be at the expense of the Contractor. Approval of the source of aggregate does not relieve the Contractor of responsibility for delivery at the jobsite of aggregates that meet the requirements specified herein.

1.9.2 Bituminous Materials

Samples of bituminous materials shall be obtained by the Contractor; sampling shall be in accordance with ASTM D 140. Tests necessary to determine conformance with requirements specified herein will be performed by the Contractor without cost to the Government. Sources where bituminous materials are obtained shall be selected in advance of the time when materials will be required in the work. In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure some condition of handling or storage has not been detrimental to the bituminous material. The samples will be taken by the Contractor and tested by the Contractor.

1.9.3 Bituminous Mixtures

Sampling and testing of bituminous mixtures will be accomplished by the Contracting Officer.

1.10 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.10.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such manner as to preclude fracturing of aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

1.10.2 Bituminous Materials

Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh buckets shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 150 degrees C.

1.11 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of the mixtures.

PART 2 PRODUCTS

2.1 BITUMINOUS HOT MIX

Shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, of the qualities and in the proportions specified and shall conform to the requirements contained in paragraphs PROPORTIONING OF MIXTURE and ACCEPTABILITY OF WORK.

2.1.1 Aggregates

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screening, sand, and mineral filler, as required. The portion of materials retained on the 4.75 mm sieve shall be known as coarse aggregate, the portion passing the 4.75 mm sieve and retained on the 0.075 millimeter sieve as fine aggregate, and the portion passing the 0.075 millimeter sieve as mineral filler. Aggregate gradation shall conform to gradation(s) specified in VDOT Section 211; Type SM-2A, SM-2B, or SM-2C Surface Course and Type IM-1A or IM-2A Intermediate Course.

2.1.1.1 Coarse Aggregate

Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

a. Percentage of loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.

b. Percentage of loss shall not exceed 20 after five cycles performed in accordance with ASTM C 88, using magnesium sulfate.

c. The dry weight of crushed slag shall not be less than 1200 kg/cubic m, as determined in accordance with ASTM C 29.

d. Crushed gravel retained on the 4.75 mm sieve and each coarser sieve shall contain at least 75 percent by weight of crushed pieces having one or more fractured faces with the area of each face equal to at least 75 percent of the smallest midsectional area of piece. When two fractures are contiguous, the angle between planes of fractures shall be at least 30 degrees to count as two fractured faces.

e. Particle shape of crushed aggregates shall be essentially cubical. The quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight, when determined in accordance with ASTM D 4791.

2.1.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles including natural sand or crushed stone, slag, or gravel that meets requirements for wear and soundness specified for coarse aggregate. Fine aggregate produced

by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the 0.600 millimeter sieve. This requirement shall apply to the material before blending with natural sand when blending is necessary. Quantity of natural sand to be added to the wearing- and intermediate-course mixtures shall not exceed 25 percent by weight of coarse and fine aggregate and material passing the 0.075 millimeter sieve. Natural sand shall be clean and free from clay and organic matter. Percentage of loss shall not exceed 25 after five cycles of the soundness test performed in accordance with ASTM C 88, using magnesium sulfate.

2.1.1.3 Mineral Filler

Grain size shall be determined in accordance with ASTM D 422.

2.1.2 Bituminous Material

Asphalt cement shall conform to ASTM D 3381, Grade AC-20.

2.1.3 Additives

The use of additives such as antistripping and antifoaming agents is subject to approval.

2.2 PROPORTIONING OF MIXTURE

2.2.1 Job Mix Formula

The JMF for the bituminous mixture will be furnished by the Contractor. The Contractor shall furnish samples of materials for mix design. Blending of the aggregates will be accomplished by the Contractor. No payment will be made for mixtures produced prior to the approval of the JMF. The formula will indicate the percentage of each stockpile and mineral filler, the percentage of each size aggregate, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. Tolerances are given in TABLE II for asphalt content, temperature, and aggregate grading for tests conducted on the mix as discharged from the mixing plant; however, the final evaluation of aggregate gradation and asphalt content will be based on paragraph ACCEPTABILITY OF WORK. Bituminous mix that deviates more than 14 degrees C from the JMF shall be rejected. The JMF may be adjusted during construction to improve paving mixtures, as directed, without adjustments in the contract prices.

TABLE II. JOB-MIX TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing 4.75 mm sieve or larger	5 percent
Aggregate passing 2.36, 1.18, 0.6, and 0.3 mm sieves	4 percent
Aggregate passing 150 and 75 micrometer sieves	2 percent
Bitumen	0.25 percent
Temperature of mixing	14 degrees C

2.2.2 Test Properties of Bituminous Mixtures

Finished mixture shall meet requirements described below when tested in accordance with VDOT Methods. All samples will be compacted with 50 blows of specified hammer on each side of sample. When bituminous mixture fails

to meet the requirements specified below, the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

2.2.2.1 Stability, Flow, and Voids

Requirements for stability, flow, and voids are shown in TABLES III and IV for nonabsorptive and absorptive aggregates, respectively.

TABLE III. NONABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
Stability minimum, newtons	4400	4400
Flow maximum, 25/100-millimeter units	14	14
Voids total mix, percent (1)	3-6	3-6
Voids filled with bitumen, percent (2)	65-80	65-80

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

TABLE IV. ABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
Stability minimum, newtons	4400	4400
Flow maximum, 25/100-millimeter units	14	14
Voids total mix, percent (1)	3-6	3-6
Voids filled with bitumen, percent (2)	65-80	65-80

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

a. When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined in accordance with ASTM C 127and ASTM C 128, the aggregate is designated as nonabsorptive. The theoretical specific gravity computed from the apparent specific gravity or ASTM D 2041 will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet requirements in TABLE III.

b. When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in ASTM D 2041 shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in TABLE IV.

2.2.2.2 Stability

The index of retained stability must be greater than 75 percent as determined by VDOT methods. When the index of retained stability is less than 75, the aggregate stripping tendencies may be countered by the use of hydrated lime or by treating the bitumen with an approved antistripping agent. The hydrated lime is considered as mineral filler and should be considered in the gradation requirements. The amount of hydrated lime or antistripping agent added to bitumen shall be sufficient, as approved, to produce an index of retained stability of not less than 75 percent. No additional payment will be made to the Contractor for addition of antistripping agent required.

PART 3 EXECUTION

3.1 BASE COURSE CONDITIONING

The surface of the base course will be inspected for adequate compaction and surface tolerances specified in Section 02722 GRADED, CRUSHED AGGREGATE BASE COURSE. Unsatisfactory areas shall be corrected.

3.2 EXISTING PAVEMENT CONDITIONING

3.3 PREPARATION OF BITUMINOUS MIXTURES

Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 150 degrees C. Temperature of aggregate and mineral filler in the mixer shall not exceed 160 degrees C when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

3.4 WATER CONTENT OF AGGREGATES

Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test will be conducted in accordance with ASTM D 2216; the weight of the sample shall be at least 500 grams. If the water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

3.5 STORAGE OF BITUMINOUS PAVING MIXTURE

Storage shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

3.6 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

3.7 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing of the intermediate or wearing course, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

3.8 NOT USED

3.9 PRIME AND TACK COATING

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a coat of bituminous material conforming to VDOT Section 310 in accordance with Section 02748 BITUMINOUS TACK AND PRIME COATS.

3.10 PLACING

Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided.

3.10.1 Offsetting Joints

The wearing course shall be placed so that longitudinal joints of the wearing course will be offset from joints in the intermediate course by at least 300 mm. Transverse joints in the wearing course shall be offset by at least 600 mm from transverse joints in the intermediate course.

3.10.2 General Requirements for Use of Mechanical Spreader

Range of temperatures of mixtures, when dumped into the mechanical spreader, shall be as determined by the Contracting Officer. Mixtures having temperatures less than 110 degrees C when dumped into the mechanical spreader shall not be used. The mechanical spreader shall be adjusted and the speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section indicated. Placing with respect to center line areas with crowned sections or high side of areas with one-way slope shall be as directed. Each lot of material placed shall conform to requirements specified in paragraph ACCEPTABILITY OF WORK. Placing of the mixture shall be as nearly continuous as possible, and speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected.

3.10.3 Placing Strips Succeeding Initial Strips

In placing each succeeding strip after initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 50 to 75 mm and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by use of a lute. Excess mixture shall be removed and wasted.

3.10.4 Handspreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to required grade, density, and thickness.

3.11 COMPACTION OF MIXTURE

Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Crown, grade, and smoothness will be checked in each lot of completed pavement by the Contracting Officer for compliance and will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. After the Contractor is assured of meeting crown, grade, and smoothness requirements, rolling shall be continued until a mat density of 97.0 to 100.0 percent and a joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. The density will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

3.11.1 Testing of Mixture

At the start of the plant operation, a quantity of mixture shall be prepared that is sufficient to construct a test section at least 15 m long, two spreader widths wide and of thickness to be used in the project. Mixture shall be placed, spread, and rolled with equipment to be used in the project and in accordance with the requirements specified above. This test section shall be tested and evaluated as a lot and shall conform to all specified requirements. If test results are satisfactory, the test section shall remain in place as part of the completed pavement. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to plant operations and rolling procedures shall be made immediately, and test section will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. Additional test sections, as directed, shall be constructed and sampled for conformance to specification requirements. In no case shall the Contractor start full production of an intermediate or wearing course mixture without approval.

3.11.2 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to VDOT Section 310. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

3.12 JOINTS

3.12.1 General

Joints between old and new pavements, between successive work days, or

joints that have become cold (less than 80 degrees C) shall be made to insure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to VDOT Section 310. Material shall be applied far enough in advance of placement of a fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

3.12.2 Transverse Joints

The roller shall pass over the unprotected end of a strip of freshly placed material only when placing is discontinued or delivery of the mixture is interrupted to the extent that the material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of a strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

3.12.3 Longitudinal Joints

Edges of a previously placed strip shall be prepared such that the pavement in and immediately adjacent to the joint between this strip and the succeeding strip meets the requirements for grade, smoothness, and density specified in paragraph ACCEPTABILITY OF WORK.

3.13 ACCEPTABILITY OF WORK

3.13.1 General

The Contractor will conduct all initial acceptance tests. Additional tests required to determine acceptability of nonconforming material will be preformed by the Government at the expense of the Contractor.

3.13.2 NOT USED

3.13.3 Asphalt Content

The percent payment based on asphalt content shall be the value determined in TABLE VI. Asphalt content tests shall be completed and reported within 24 hours after construction of each 1,000 metric tons, or fraction thereof.

TABLE VI. PERCENT PAYMENT BASED ON ASPHALT CONTENT

Mean Absolute Deviation of Extracted Asphalt Content from JMF	Percent Payment
0.25 - 0.40	100
above 0.40	reject

3.13.4 Density

The laboratory density for each 500 metric tons of bituminous course placed

will be determined in accordance with VDOT accepted methods from four sets of laboratory samples. Laboratory samples will be prepared from asphalt mixture which has not been reheated. Samples will be compacted at 121.1 degrees C within 2 hours of the time the mixture was prepared at the asphalt plant. Laboratory samples will be prepared in accordance with VDOT accepted methods.

3.13.4.1 NOT USED

3.13.4.2 Density

All density results for each 500 metric tons placed will be completed and reported within 24 hours after construction of that lot. When the Contracting Officer considers it necessary to take additional samples for density measurements, samples will be taken in groups of four. The Contractor shall fill all sample holes with hot mix and compact.

3.13.5 Grade

Grade-conformance tests will be conducted by the Contractor. The finished surface of the pavement will be tested for conformance with plan-grade requirements. The finished grade of each pavement area shall be determined by running lines of levels at intervals of 8 m or less longitudinally and transversely to determine the elevation of the completed pavement. When more than 5 percent of all measurements made within a lot are outside the tolerances specified in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS, the Contractor shall correct the deficiencies at no cost to the Government. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

3.13.6 Surface Smoothness

After completion of final rolling of a lot, the compacted surface will be tested by the Contractor with a 3.66 m straightedge. Measurements will be made perpendicular to and across all mats at distances along the mat not to exceed 8 m. Location and deviation from straightedge of all measurements will be recorded. When more than 5 percent of all measurements along the mat within a lot exceed the specified tolerance, the Contractor shall correct all deficient areas at no cost to the Government. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

-- End of Section --

SECTION 02580

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952	(Rev D) Paint, Traffic and Airfield Marking, Waterborne (Metric)

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Lists; GA.

Lists of proposed equipment to be used in performance of construction work, including descriptive data, and notifications of proposed Contractor actions as specified in this section.

SD-06 Instructions

Mixing, Thinning and Application; FIO.

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

SD-09 Reports

Material Tests; FIO.

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-13 Certificates

Volatile Organic Compound (VOC) Content; GA.

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways will display low speed traffic markings and traffic warning lights.

1.5.1 Paint Application Equipment

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 8 kilometers per hour, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. The equipment used to apply the paint binder to airfield pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with an arrangement of atomizing nozzles capable of applying a line width at any one time in multiples of 150 mm, from 150 mm to 900 mm. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to insure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.5.2 NOT USED

1.5.3 NOT USED

1.5.4 NOT USED

1.5.5 Surface Preparation Equipment

1.5.5.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 70.8 liters per sec of air at a pressure of not less than 620 kPa at each nozzle used, and shall be equipped with traps that will maintain the compressed

air free of oil and water.

1.5.5.2 Waterblast Equipment

The water pressure shall be specified at 17.9 MPa at 60 degrees C in order to adequately clean the surfaces to be marked.

1.5.6 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces shall be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields and roadways shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 NOT USED

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number,

intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings that are in good condition that interfere with or conflict with the newly applied marking patterns shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the

valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 5 degrees C and less than 35 degrees C. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified herein. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 2.9 plus or minus 0.5 square meter per liter.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

-- End of Section --

SECTION 02620

SUBDRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 190	(1988) Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990; R 1995) Ferritic Malleable Iron Castings
ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 227/A 227M	(1993) Steel Wire, Cold-Drawn for Mechanical Springs
ASTM A 229/A 229M	(1993) Steel Wire, Oil-Tempered for Mechanical Springs
ASTM A 760/A 760M	(1995b) Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A 762/A 762M	(1995a) Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM B 745/B 745M	(1995) Corrugated Aluminum Pipe for Sewers and Drains
ASTM C 14	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 55	(1996a) Concrete Brick
ASTM C 62	(1996) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 139	(1996a) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 150	(1996) Portland Cement

ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 425	(1996) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 444	(1995) Perforated Concrete Pipe
ASTM C 478	(1996) Precast Reinforced Concrete Manhole Sections
ASTM C 654	(1995) Porous Concrete Pipe
ASTM C 700	(1996) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2751	(1993) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 5034	(1995) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM F 405	(1996) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F 667	(1985) Large Diameter Corrugated Polyethylene Tubing and Fittings
ASTM F 758	(1993) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 949	(1994) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT	Road and Bridge Specifications

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Filter Fabric; GA. Pipe for Subdrains; GA.

Certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe, drain tile, fittings, and filter fabric.

1.3 DELIVER, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with minimum handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. During shipment and storage, filter fabric shall be wrapped in burlap or similar heavy duty protective covering. The storage area shall protect the fabric from mud, soil, dust, and debris. Filter fabric materials that are not to be installed immediately shall not be stored in direct sunlight. Plastic pipe shall be installed within 6 months from the date of manufacture unless otherwise approved.

1.3.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried and not dragged to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR SUBDRAINS

Pipe for subdrains shall be of the types and sizes indicated.

2.1.1 Concrete Pipe

Concrete pipe shall be Class 1, 2, or 3 as indicated and shall conform to ASTM C 14 using ASTM C 150 portland cement Type II.

2.1.2 Clay Pipe and Perforated Clay Pipe

2.1.2.1 Clay Pipe

Clay pipe shall be either standard or extra strength as indicated and shall conform to ASTM C 700.

2.1.2.2 Perforated Clay Pipe

Perforated clay pipe shall be either standard or extra strength as indicated and shall conform to ASTM C 700. Plain-end pipe conforming to the strength and perforation requirements of ASTM C 700 will also be acceptable if provided with spring wire clips of approved type to maintain a taut but elastic joint between the sections of pipe when laid. Clips shall be constructed of not smaller than No. 9 hard-drawn or oil-tempered steel wire conforming to ASTM A 227/A 227M or ASTM A 229/A 229M, and shall be coated with an approved rust preventive coating. Wire clips shall

withstand 25 cycles of alternate loading and unloading using a stressing force of 556 N. The permanent set resulting from this test shall be less than 5 percent, based on the original length of the fastener. Compression joints conforming to ASTM C 425 will also be acceptable.

2.1.3 Perforated Concrete Pipe

Perforated concrete pipe shall conform to ASTM C 444, Type II perforations and to ASTM C 14, Class 1, 2, or 3 as indicated.

2.1.4 NOT USED

2.1.5 Perforated Corrugated Steel Pipe, Fully Bituminous Coated

Perforated corrugated steel pipe, fully bituminous coated, shall conform to ASTM A 760/A 760M, Type III, with a coating conforming to AASHTO M 190, Type A. Sheet thickness of pipe shall be as indicated.

2.1.6 NOT USED

2.1.7 Porous Concrete Pipe

Porous concrete pipe shall conform to ASTM C 654, standard or extra strength as indicated and using ASTM C 150 portland cement Type II.

2.1.8 Perforated Corrugated Aluminum Alloy Pipe

Perforated corrugated aluminum alloy pipe shall conform to ASTM B 745/B 745M, Type III, Class 1. Sheet thickness of pipe shall be as indicated.

2.1.9 NOT USED

2.1.10 Precoated Corrugated Steel Pipe

Precoated corrugated steel pipe shall conform to ASTM A 762/A 762M, Type III.

2.1.11 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.11.1 Acrylonitrile-Butadiene-Styrene (ABS) Piping

Acrylonitrile-butadiene-styrene (ABS) piping and fittings shall conform to ASTM D 2751, with maximum SDR of 35.

2.1.11.2 Polyvinyl Chloride (PVC) Pipe and Fittings

Polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D 3034, ASTM F 949, or ASTM F 758, Type PS 46.

2.1.11.3 Corrugated Polyethylene (PE) Pipe and Fittings

Use ASTM F 405 for pipes 80 to 150 mm in diameter, inclusive, ASTM F 667 for pipes 200 to 600 mm in diameter. Fittings shall be manufacturer's standard type and shall conform to the indicated specification.

2.1.11.4 Pipe Perforations

Water inlet area shall be a minimum of 1,058.4 mm squared per linear meter. Manufacturer's standard perforated pipe which essentially meets these requirements may be substituted with prior approval of the Contracting Officer.

a. Circular Perforations in Plastic Pipe: Circular holes shall be cleanly cut not more than 9.5 mm or less than 4.8 mm in diameter and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 76.2 mm center-to-center along rows. The rows shall be approximately 38.1 mm (1-1/2 inches) apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket, and perforations shall continue at uniform spacing over the entire length of the pipe.

b. Slotted Perforations in Plastic Pipe: Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 3.2 mm nor be less than 0.8 mm. The length of individual slots shall not exceed 31.75 mm on 80 mm diameter tubing, 10 percent of the tubing inside nominal circumference on 100 to 200 mm diameter tubing, and 63.5 mm on 250 mm diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in 2 quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe.

2.2 FILTER FABRIC

Filter fabric shall be a pervious sheet of polyester, nylon, or polypropylene filaments woven or otherwise formed into a uniform pattern with distinct and measurable openings. The filter fabric shall provide an equivalent opening size (AOS) no finer than the US Standard Sieve No. 120 and no coarser than the US Standard Sieve No. 70. AOS is defined as the number of the US Standard sieve having openings closest in size to the filter fabric openings. The fabric shall have a minimum physical strength of 444.8 N per meter in any direction when tested in accordance with ASTM D 5034 using the grab test method with 645.2 square mm jaws and a constant rate of travel of 304.8 mm per minute. Elongation at failure shall be between 30 and 70 percent. The fabric shall be constructed so that the filaments will retain their relative position with respect to each other. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer material from pulling away from the fabric.

2.3 DRAINAGE STRUCTURES

2.3.1 Concrete

Except for precast concrete, reinforcement shall conform to the requirements for 21 MPa concrete in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixtures shall have air content, by volume of concrete, based on measurements made immediately after discharge from the mixer of 5 to 7 percent when coarse-aggregate maximum size is 38.1 mm or smaller. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall be not less than 25.4 mm

thick for covers and not less than 38.1 mm thick for walls and flooring. Concrete covering deposited directly against the ground shall be at least 76.2 mm thick between the steel and the ground. Expansion-joint filler material shall conform to ASTM D 1751 or ASTM D 1752. Exposed concrete surfaces, such as drainage structures that form a continuation of concrete curbs and gutters, shall be given a protective coating of linseed oil as specified in Section 02511CONCRETE SIDEWALKS AND CURBS AND GUTTERS.

2.3.2 Mortar

Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of portland cement and two parts of sand. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with water.

2.3.3 Manholes and Appurtenances

2.3.3.1 Precast Reinforced Concrete Manhole Risers and Tops

Precast reinforced concrete manhole risers and tops shall conform to ASTM C 478.

2.3.3.2 Precast Concrete Segmental Blocks

Precast concrete segmental blocks shall conform to ASTM C 139 and shall be not more than 203.2 mm thick, not less than 203.2 mm long, and of such shape that the joints can be effectively sealed and bonded with cement mortar.

2.3.3.3 Precast Concrete Manhole Bases

If precast concrete manhole bases are used, the bases shall conform to ASTM C 478 and shall be of such a design as to effect suitable connection with influent and effluent lines and to provide a suitable base structure for riser sections.

2.3.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW, or ASTM C 55, Grade S-I or S-II. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in the amount of not more than 25 percent by volume of cement.

2.3.3.5 NOT USED

2.3.3.6 NOT USED

2.3.3.7 Frames and Covers or Gratings

Frames and gratings, or frames and covers, except as otherwise permitted, shall be of either cast iron with tensile strength test not less than ASTM A 48 Class 25 or steel conforming to ASTM A 27/A 27M , Class 65-35. Weight, shape, and size shall be as indicated. Frames and covers not subjected to vehicular traffic or storage may be of malleable iron where indicated. The malleable-iron frames and covers shall conform to ASTM A 47 and shall be of the weight, shape, and size indicated.

2.3.3.8 Steel Ladder

A steel ladder shall be provided where the depth of a manhole exceeds 3.66 m. The ladder will be not less than 400 mm in width, with 19.1 mm diameter rungs spaced 304.8 mm apart. The two stringers shall be a minimum 9.5 mm thick and 50.8 mm wide. Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 1.83 m apart vertically, and shall be so installed as to provide at least 152.4 mm of space between the wall and the rungs. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123. The wall along the line of the ladder shall be vertical for its entire length.

2.4 SUBDRAIN FILTER AND BEDDING MATERIAL

Subdrain filter and bedding material shall conform to VDOT Section 203 for Size No. 78 or No. 8, minimum Grade B.

PART 3 EXECUTION

3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified for cohesionless material in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 NOT USED

3.3 INSTALLATION OF FILTER FABRIC AND PIPE FOR SUBDRAINS

3.3.1 Installation of Filter Fabric

3.3.1.1 NOT USED

3.3.1.2 NOT USED

3.3.1.3 Trench Lining and Overlaps

Trenches to be lined with filter fabric shall be graded to obtain smooth side and bottom surfaces so that the fabric will not bridge cavities in the soil or be damaged by projecting rock. The fabric shall be laid flat but not stretched on the soil, and it shall be secured with anchor pins. Overlaps shall be at least 150 mm, and anchor pins shall be used along the overlaps.

3.3.2 Installation of Pipe for Subdrains

3.3.2.1 Pipelaying

Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. No pipe shall be laid when the trench conditions or weather is unsuitable for such work. Water shall be removed from trenches by sump pumping or other approved methods. The pipe shall be laid to the grades and alignment as indicated. The pipe shall be bedded to the established gradeline. Perforations shall be centered on the bottom of the pipe. Pipes of either the bell-and-spigot type or the

tongue-and-groove type shall be laid with the bell or groove ends upstream. All pipes in place shall be approved before backfilling.

3.3.2.2 Jointings

a. Nonperforated Concrete and Clay Pipe: Pipe shall be laid with 3.2 to 6.4 mm opening between the ends of the pipe or as required by spacing lugs constructed in the pipe. Mortar shall be placed in the joint at three points and pressed firmly into place to hold the pipe securely in line. The mortar shall be the full depth of the bell or groove and approximately 25.4 in width, and shall be located at the third points around the joint with the top point at the center of the pipe. The inside of the pipe shall be free of excess mortar.

b. Perforated Concrete and Clay Pipe: The pipe shall be laid with closed joints with positive provision for centering each section of the pipe in the bell or groove of the previously placed section. Plain-end perforated clay pipe sections shall be securely fastened together with spring wire clips furnished by the pipe manufacturer.

c. Perforated Corrugated Metal Pipe or Bituminous Coated, Perforated Corrugated Metal Pipe: The sections of perforated corrugated metal pipe or bituminous coated, perforated corrugated metal pipe shall be securely fastened together with standard connecting bands furnished by the manufacturer of the pipe.

d. Porous Concrete Pipe: Porous concrete pipe shall be installed with mortar joints.

g. Bituminous Coated or Uncoated Semicircular Steel Pipe: Coupling bands shall consist of an uncorrugated top and bottom section fabricated to fit around two adjacent pieces of pipe. Coupling bands shall be bolted together with four bolts.

h. Bituminous Coated or Uncoated Corrugated Aluminum Pipe: If aluminum pipe is to be connected to dissimilar metal, the connection shall be insulated by bituminous coating or other nonconductive material. Standard joints between corrugated aluminum pipe shall be securely fastened with standard connecting bands furnished by the manufacturer of the pipe.

i. Acrylonitrile-Butadiene-Styrene (ABS): Solvent cement or elastomeric joints for ABS pipe shall be in accordance with ASTM D 2751. Dimensions and tolerances shall be in accordance with TABLE II of ASTM D 2751.

j. Polyvinyl Chloride (PVC) Pipe: Joints shall be in accordance with the requirements of ASTM D 3034, ASTM D 3212, or ASTM F 949.

k. Perforated Corrugated Polyethylene Pipe: Perforated corrugated polyethylene drainage pipe shall be installed in accordance with the manufacturer's specifications and as specified herein. A pipe with physical imperfections shall not be installed. No more than 5 percent stretch in a section will be permitted.

3.4 INSTALLATION OF AND BACKFILLING FOR BLIND OR FRENCH DRAINS

Filter material shall be placed as indicated and compacted as specified for

cohesionless materials in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Filter material shall extend to a suitable outlet or to an outlet through a pipeline as indicated. Overlying backfill material shall be placed and compacted as specified in Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.5 INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

After pipe for subdrains has been laid, inspected, and approved, filter material shall be placed around and over the pipe to the depth indicated. The filter material shall be placed in layers not to exceed 200 mm thick, and each layer shall be thoroughly compacted by mechanical tampers or rammers to obtain the required density. Compaction of filter material and the placement and compaction of overlying backfill material shall be in accordance with the applicable provisions specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

-- End of Section --

SECTION 02660

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1994a) Carbon Structural Steel
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM D 1599	(1988) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1993) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1993) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1993) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1990) Heat-Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM F 477	(1993) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1988) Flanged Ductile-Iron Pipe with Threaded Flanges
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(1994) Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water and Other Liquids
AWWA C200	(1991) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C300	(1989) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C301	(1992) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids

AWWA C303	(1987; Errata Jan 1988) Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids
AWWA C500	(1993) Gate Valves for Water and Sewerage Systems
AWWA C502	(1985) Dry-Barrel Fire Hydrants
AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C700	(1990; C700a) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C702	(1992) Cold-Water Meters - Compound Type
AWWA C703	(1986) Cold-Water Meters - Fire Service Type
AWWA C704	(1992) Cold-Water Meters - Propeller Type for Main Line Applications
AWWA C706	(1991; C706a) Direct-Reading Remote-Registration Systems for Cold-Water Meters
AWWA C707	(1982; R 1992) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1988; Errata Apr 1988) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA C905	(1988) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
AWWA C950	(1988) Fiberglass Pressure Pipe

AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA-01	(1988) Recommended Work Practices for A/C Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1992) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1991) Hazardous Chemicals Data
NFPA 325M	(1991) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1990) Identification of the Fire Hazards of Materials

NSF INTERNATIONAL (NSF)

NSF Std 14	(1965; Rev Nov 1990) Plastics Piping System Components and Related Materials

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 1.5 m outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines less than 80 mm in diameter shall be polyvinyl chloride (PVC) plastic, polyethylene, or copper tubing, unless otherwise shown or specified. Piping for water service lines for sizes 80 mm and larger shall be ductile iron, polyvinyl chloride (PVC) plastic through 300 mm nominal diameter, filament-wound or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe, unless otherwise shown or specified.

1.2.2 Distribution Lines 80 mm or Larger

Piping for water distribution lines 80 mm or larger shall be ductile iron, polyvinyl chloride (PVC) plastic through 300 mm nominal diameter, filament-wound or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe, or reinforced concrete, unless otherwise shown or specified.

1.2.3 NOT USED

1.2.4 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 1.5 m line.

1.2.5 Plastic Pipe

All plastic piping system components (PVC, polyethylene, thermosetting resin and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

1.2.6 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 NOT USED

1.4 MANUFACTURER'S REPRESENTATIVE

The Contractor shall negotiate to have a manufacturer's field representative present at the jobsite during the installation and testing of PE, RTRP, and/or RPMP pipe to provide technical assistance and to verify that the materials are being installed in accordance with the manufacturer's prescribed procedures. When the representative feels that the Contractor is installing and testing the PE, RTRP, and/or RPMP pipe in a satisfactory manner, certification shall be written to note which individuals employed by the Contractor are capable of properly installing the pipe. The field representative shall advise the Contractor of unsatisfactory conditions immediately when they occur. Such conditions include improper diameter of pipe ends, damaged interior liner, poorly prepared joints, improper curing of joints, moving pipe before joints are cured, bending pipe to follow abrupt changes in trench contours, leaving pipe ends open in trench overnight, not properly drying joints after rain storms, exceeding effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction or any other conditions which could have an adverse effect on the satisfactory completion and operation of the piping system.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-06 Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

SD-08 Statements

Waste Water Disposal Method; GA.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation; FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09 Reports

Bacteriological Disinfection; GA.

Test results from commercial laboratory verifying disinfection.

1.6 HANDLING

Pipe and accessories shall be handled so as to ensure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.6.1 NOT USED

1.6.2 Polyethylene (PE) Pipe

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901.

1.6.3 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA

704, with classification as indicated in NFPA 49 and NFPA 325M.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Reinforced and Prestressed Concrete Pipe

Steel-cylinder reinforced concrete pipe shall conform to AWWA C300, AWWA C301, or AWWA C303 and shall be designed to withstand a working pressure of not less than 1.03 MPa unless otherwise shown or specified.

2.1.2 Plastic Pipe

2.1.2.1 Polyethylene Plastic (PE)

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.2.2 Polyvinyl Chloride (PVC) Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 100 mm Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 1.03 MPa working pressure, 1.38 MPa hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785. Schedule 40 with joints meeting the requirements of 1.03 MPa working pressure, 1.38 MPa hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure MPa	Minimum Hydrostatic Pressure MPa
26	0.689	0.917
21	0.827	1.103
17	1.034	1.379
13.5	1.379	1.834

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 MPa working pressure and 1.38 MPa hydrostatic test pressure.

b. Pipe 100 mm through 300 mm Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

c. Pipe 350 mm through 900 mm Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

2.1.3 Reinforced Plastic Mortar Pressure (RPMP) Pipe

AWWA C950.

2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

2.1.4.1 RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 1.03 MPa (150 psi) at 23 degrees C. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.4.2 RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.1.5 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 1.03 MPa, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

2.1.6 NOT USED

2.1.7 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.2 FITTINGS AND SPECIALS

2.2.1 Reinforced Concrete Pipe

Fittings and specials required for closures, curves, bends, branches and connections to valves, pipe, or structures shall be approved by the Contracting Officer and conform to the details furnished by the manufacturer and to AWWA C300, AWWA C301, or AWWA C303 as applicable.

2.2.2 Polyvinyl Chloride (PVC) Pipe

a. For pipe less than 100 mm diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings, fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467, and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall be cement-mortar lined (standard

thickness) in accordance with AWWA C104.

b. For pipe 100 mm diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 1.03 MPa pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.2.3 RTRP and RPMP Pipe

Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 150 mm shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104 and shall conform to AWWA C110 and AWWA C111. Fittings shall be suitable for working and testing pressures specified for the pipe.

2.2.4 Ductile-Iron Pipe

Fittings and special shall be suitable for 1.03 MPa pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

2.2.5 NOT USED

2.2.6 Copper Tubing

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 Reinforced Concrete Pipe

Rubber-gasket joints shall be of the type using a bell-and-spigot joint design of steel. The gaskets shall conform to AWWA C300, AWWA C301, or AWWA C303, as applicable.

2.3.2 Plastic Pipe

2.3.2.1 Polyethylene (PE) Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contracting Officer.

2.3.2.2 Polyvinyl Chloride Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations as approved by the Contracting Officer.

2.3.3 RPMP Pipe

Joints shall be mechanical or bell and spigot type with elastomeric gasket.

2.3.4 RTRP

2.3.4.1 RTRP-I, Grade I and 2

Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

2.3.4.2 RTRP-II, Grade 1 and 2

Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

2.3.5 Ductile-Iron Pipe

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricant shall conform to the applicable requirements of AWWA C111.

2.3.6 NOT USED

2.3.7 Bonded Joints

For all ferrous pipe, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond wire shall be Size 1/0 copper conductor suitable for direct burial shaped to stand clear of the joint. The bond shall be of the thermal weld type.

2.3.8 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground

installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.3.9 Copper Tubing

Joints shall be compression-pattern flared and shall be made with fittings hereinafter specified.

2.4 VALVES

2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 1.03 MPa or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 50 mm and larger shall be outside lever and spring type.

a. Valves 50 mm and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 50 mm shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 1.03 MPa. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 80 mm shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 80 mm and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient-Seated Gate Valves: For valves 80 to 300 mm in size, resilient-seated gate valves shall conform to AWWA C509.

2.4.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 80 mm through 250 mm in diameter may be direct

burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.4.4 NOT USED

2.4.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.4.6 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which will be attached to each post.

2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 5 mm. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.6 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 21 MPa in accordance with Section 03300CAST-IN-PLACE STRUCTURAL CONCRETE.

2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA C502 with valve opening at least 125 mm in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 200 mm above the ground grade. Hydrants shall have a 150 mm bell connection, two 65 mm hose connections and one 115 mm pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be similar and equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with one coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and two finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the installation's standard colors or as directed by the Contracting Officer. Suitable bronze adapter for each outlet, with caps, shall be furnished.

2.8 NOT USED

2.9 MISCELLANEOUS ITEMS

2.9.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.9.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.9.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.9.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 1.375 MPa.

2.9.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable-iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 1.03 MPa. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 67.8 Newton meters.

2.9.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.9.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.9.8 Meters

Meters shall be the type and size shown on the drawings or specified herein. Meters of each of the various types furnished and installed under this contract shall be supplied by one manufacturer.

2.9.8.1 Displacement Type

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in U.S. gallons. Meters in sizes 13 mm through 25 mm shall be frost-protection design. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C700.

2.9.8.2 Turbine Type

Turbine type meters shall conform to AWWA C701 Class I. The main casing shall be cast iron protected by corrosion resistant coating with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

2.9.8.3 Compound Type

Compound type meters shall conform to AWWA C702 and shall be furnished with strainers. The main casing shall be cast iron protected by corrosion resistant coating with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C702.

2.9.8.4 Fire Service Type

Fire service type meters shall be proportional type or turbine type conforming to AWWA C703 and shall be furnished with strainers. The main casing shall be cast iron protected by corrosion resistant coating with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA

C707. Meters shall comply with the accuracy and capacity requirements of AWWA C703. When turbine type main line meters are used, the meter shall be supplied with a separate check valve, as a unit.

2.9.8.5 Propeller Type

Propeller type meters shall conform to AWWA C704. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C703.

2.9.9 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. The boxes shall be of sufficient size to completely enclose the meter and shut-off valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall be concrete with cast iron lid and cast iron meter reader lid. Plastic boxes and lids shall be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

2.10 Meter Vaults

Large meters shall be installed in reinforced concrete vaults in accordance with the details shown on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 3 m from a sewer except where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 1.8 m from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 3 m each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 900 mm horizontally of the crossing. Water lines shall in all cases cross

above sewage force mains or inverted siphons and shall be not less than 600 mm above the sewer main. Joints in the sewer main, closer horizontally than 900 mm to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 300 mm shall be maintained between pipes.

3.1.2.5 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be steel, manufactured in accordance with AWWA C200, ASTM A 36. A minimum clearance of at least 50 mm between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the water pipe through the sleeve.

3.1.2.6 Structures

Where water pipe is required to be installed within 1 m of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall take proper precautions during installation of the water pipe and sleeve to ensure that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Reinforced Concrete Pipe

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be 5 degrees for reinforced concrete pipe unless a lesser amount is recommended by the manufacturer. Long radius curves in reinforced concrete pipe shall be formed by straight pipe in which spigot rings are placed on a bevel. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflections does not exceed the maximum recommended by the pipe manufacturer. Short-radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated specials specified.

3.1.3.2 Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but in no case shall it exceed 5 degrees.

3.1.3.3 Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Reinforced Concrete Pipe Installation

Reinforced concrete pipe shall be installed in accordance with recommendations of the pipe manufacturer. Before laying reinforced concrete pipe, the outside surface of the spigot and the inside surface of the bell shall be cleaned and an acceptable vegetable-compound lubricant applied to the inside surface of the bell and to the rubber gasket. Where prescribed by the pipe manufacturer, the gasket shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber gasket shall be checked with a feeler gauge in accordance with the pipe manufacturer's recommendations. Tapping of reinforced concrete cylinder pipe shall be done in accordance with the manufacturer's approved recommendations. Where the manufacturer recommends that the taps be made by attaching the rubber-gasketed saddle to the outside of the pipe using U-bolts, the saddle shall be grouted in if necessary, the mortar coating shall be chipped away even with the hole in the saddle plate. The exposed circumferential wires shall be removed and the cylinder and concrete core drilled out, and the steel saddle and U-bolts shall be protected by concrete encasement.

3.1.4.2 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the recommendations of the manufacturer. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.3 Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA-01.

3.1.4.4 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.5 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 Reinforced-Concrete Pipe

The inside and outside annular spaces between abutting sections of concrete pipe shall be filled with rich cement mortar in accordance with the recommendations of the pipe manufacturer. Excess mortar shall be removed from interior annular spaces, leaving a smooth and continuous surface between pipe sections. Exposed portions of steel joint rings shall be protected from corrosion by a metallic coating or by an approved nonmetallic coating. Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the recommendations of the pipe manufacturer.

3.1.5.2 Polyethylene (PE) Pipe

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

3.1.5.3 Polyvinyl Chloride (PVC) Plastic Pipe

a. Pipe less than 100 mm diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 100 mm through 300 mm diameter: Joints shall be elastomeric-gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 100 mm diameter with configuration using elastomeric ring gasket.

3.1.5.4 RTRP I, RTRP II and RPMP Pipe

a. RTRP I: Assembly of the pipe shall be done in strict conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously. However, the pipe shall not be moved nor shall additional joints be made until the previously laid joints are completely cured. Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 10.3 MPa or greater when carried out in accordance with ASTM D 1599. All field bonded epoxy-cemented joints, regardless of ambient temperature, shall be cured with a self-regulating thermostatically temperature controlled electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating or until the joint has cooled to ambient temperature.

b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.

c. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 3.2 mm thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 135 Newton meters. Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

3.1.5.5 Ductile-Iron Pipe

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.6 NOT USED

3.1.5.7 NOT USED

3.1.5.8 Copper Tubing

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.9 Bonded Joints

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

3.1.5.10 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 3 mm thickness of coal tar over all fitting surfaces.

3.1.5.11 Connections

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 1.5 m outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 1.5 m from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 50 mm (2 Inches) and Smaller

Service lines 50 mm (2 inches) and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Corporation Stops, mm	Outlets w/Service

Pipe Size mm	For Ductile-Iron Pipe	Clamps, mm Single & Double Strap
80	--	25
100	25	25
150	32	40
200	40	50
250	40	50
300 & larger	50	50

3.1.6.2 Service Lines 40 mm. and Smaller

Service lines 40 mm and smaller shall have a service stop.

3.1.6.3 Service Lines 50 mm in Size

Service lines 50 mm in size shall have a gate valve.

3.1.6.4 Service Lines Larger than 50 mm

Service lines larger than 50 mm shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 80 mm and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.6.5 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 NOT USED

3.1.8 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.8.1 Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 150 mm branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 450 mm above the finished surrounding grade, and the operating nut not more than 1.2 m above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 450 mm above the finished surrounding grade, the top of the hydrant not more than 600 mm above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished gradeline immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 100 mm thick and 400 mm square. Not less than 2 cubic meters of free-draining broken stone or

gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.8.2 Meters

Vaults shall be installed at the locations shown on the drawings. The meters shall be centered in the vaults to allow for reading and ease of removal or maintenance.

3.1.8.3 Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box or pit to a distance of 1.2 m on all sides of the box, or the undisturbed trench face if less than 1.2 m.

3.1.8.4 Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.9 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 100 mm in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be thrust blocks.

3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fitting or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the contract.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 1.38 MPa pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 1.38 MPa. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain pressure within 34.5 kPa (5 psi) of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 1/2 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. Personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.3.2 Lead Residual

Following the bacteriological disinfection and testing, the system shall be flushed with a sufficient velocity of water and sufficient tests performed at each hot- and cold-water discharge point until no more than 15 ppb lead residuals remain in the system. All tests and samples shall be performed in accordance with state and, if applicable, Federal regulations. Samples for testing are to be collected after a 6-hour continuous period of no flushing, and will be considered first draw samples. The commercial

laboratory must be certified by the state's approving authority for examination of potable water. Lead residual test results are to be submitted to the Contracting Officer. The system will not be accepted until satisfactory bacteriological results and lead residual test results have been obtained. All flushing and testing for lead residuals, including all costs, are the responsibility of the Contractor.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 02714

DRAINAGE LAYER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1991a) Unit Weight and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 4791	(1995) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregates
ASTM E 548	(1994) General Criteria Used for Evaluating Laboratory Competence

1.2 NOT USED

1.3 SYSTEM DESCRIPTION

The Contractor shall build a drainage layer under the airfield and streets pavements as indicated and in accordance with the following subparagraphs:

1.3.1 Aggregate Drainage Layer

A drainage layer consisting of rapid draining materials (RDM) or a combination of open graded materials (OGM) stabilized with choke stone meeting the gradations of Table I.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Sampling and Testing; GA.

Copies of field test results within 24 hours of completion of tests.

Approval of Materials; GA.

Material sources and material test results prior to field use.

1.5 FIELD COMPACTION

Field compaction requirements shall be based on the results of a test section constructed by the Contractor, using the materials, methods, and equipment proposed for use in the work. The test section shall meet the requirements of paragraph TEST SECTION.

1.6 EQUIPMENT

1.6.1 General Requirements

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

1.6.2 Placement Equipment

An asphalt paving machine shall be used to place drainage layer material. Alternate methods may be used if it can be demonstrated in the test section that these methods obtain the specified results.

1.6.3 Compaction Equipment

A dual or single smooth drum roller which provides a maximum compactive effort without crushing the drainage layer aggregate shall be used to compact drainage layer material.

1.7 WEATHER LIMITATION

Drainage layer material shall be placed when the atmospheric temperature is above 2 degrees C. Areas of completed drainage layer or underlying courses that are damaged by freezing, rainfall, or other weather conditions

or by contamination from sediments, dust, dirt, or foreign material shall be corrected by the Contractor to meet specified requirements.

1.8 SAMPLING AND TESTING

1.8.1 General Requirements

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. If the Contractor elects to establish testing facilities of his own, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections required because of failure of the first inspection shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. Drainage layer materials shall be tested to establish compliance with the specified requirements.

1.8.2 Sampling

Aggregate samples shall be taken in accordance with ASTM D 75. Bituminous samples shall be taken in accordance with ASTM D 140. Bituminous or cement stabilized mixture samples shall be taken using methods approved by the Contracting Officer.

1.8.3 Test Methods

1.8.3.1 Sieve Analyses

Sieve analyses shall be made in accordance with ASTM C 117 and ASTM C 136.

1.8.3.2 Density Tests

Field density tests shall be made in accordance with ASTM D 2922. When using this method, ASTM D 3017 shall be used to determine the moisture content of the aggregate drainage layer material. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph "Calibration" of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed by the Contracting Officer.

1.8.3.3 Soundness Test

Soundness tests shall be made in accordance with ASTM C 88.

1.8.3.4 Los Angeles Abrasion Test

Los Angeles abrasion tests shall be made in accordance with ASTM C 131.

1.8.3.5 Flat or Elongated Particles Tests

Flat and/or elongated particles tests shall be made in accordance with ASTM D 4791.

1.8.3.6 Fractured Faces Tests

When aggregates are supplied from crushed gravel, approved test methods shall be used to assure the aggregate meets the requirements for fractured faces in paragraph AGGREGATES.

1.8.4 Testing Frequency

1.8.4.1 Aggregate Layer

Sieve analyses, field density, and moisture content tests shall be performed at a rate of at least one test for every 1000 square meters of completed area and not less than one test for each day's production. Soundness tests, Los Angeles abrasion tests, fractured faces tests and flat and/or elongated particles tests shall be performed at the rate of one test for every 10 sieve analysis tests.

1.8.5 Approval of Materials

1.8.5.1 Aggregate

The aggregate source shall be selected at least 60 days prior to field use in the test section. Tentative approval of the source will be based on certified test results to verify that materials proposed for use meet the contract requirements. Final approval of both the source and the material will be based on test section performance and tests for gradation, soundness, Los Angeles abrasion, flat and/or elongated particles tests and fractured faces tests. For aggregate drainage layer materials, these tests shall be performed on samples taken from the completed and compacted drainage layer course within the test section. For bituminous or cement stabilized drainage layer material, these tests shall be performed on aggregate samples taken prior to addition of bituminous or cementitious material and subsequent placement in the test section.

PART 2 PRODUCTS

2.1 NOT USED

2.2 AGGREGATES

Aggregates shall consist of clean, sound, hard, durable, angular particles of crushed stone, crushed slag, or crushed gravel which meet the specification requirements. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 1040 kg per cubic meter determined by ASTM C 29/C 29M. The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings.

2.2.1 Aggregate Quality

The aggregate shall have a soundness loss not greater than 18 percent weighted averaged at 5 cycles when tested in magnesium sulfate in accordance with ASTM C 88. The aggregate shall have a percentage of loss on abrasion not to exceed 40 after 500 revolutions as determined by ASTM C 131. The percentage of flat and/or elongated particles shall be determined by ASTM D 4791 with the following modifications. The aggregates shall be separated into 2 size fractions. Particles greater than 12.5 mm sieve and particles passing the 12.5 mm sieve and retained on the 4.75 mm sieve. The percentage of flat and/or elongated particles in either fraction shall not exceed 20. A flat particle is one having a ratio of width to thickness

greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements. When the aggregate is supplied from crushed gravel it shall be manufactured from gravel particles, 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the face. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as 2 fractured faces.

2.2.2 Gradation Requirements

Drainage layer aggregates shall be well graded within the limits specified in TABLE I.

TABLE I. GRADATION OF DRAINAGE LAYER MATERIAL

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	Rapid Draining Material (RDM)	Open Graded Material (OGM)	Choke Stone
37.50 mm	100	100	100
25.00 mm	70-100	95-100	100
19.00 mm	55-100	---	100
12.50 mm	40-80	25-80	100
9.50 mm	30-65	---	80-100
4.75 mm	10-50	0-10	10-100
2.36 mm	0-25	0-5	5-40
1.18 mm	0-5	---	0-10

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 1.5 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

NOTE 3: Choke stone, asphalt cement, or portland cement will be required to stabilize the OGM. Choke stone shall be made up of hard, durable, crushed aggregate having 90 percent of the stone with fractured faces. The gradation for the choke stone shall be based on the following criteria:

a. The ratio of the D15 of the OGM to the D15 of the choke stone shall be less than 5.

b. The ratio of the D50 of the OGM to the D50 of the choke stone shall be greater than 2.

NOTE 4: For RDM, the coefficient of uniformity (CU) shall be greater than 3.5. (CU = D60/D10).

PART 3 EXECUTION

3.1 STOCKPILING AGGREGATES

Aggregates shall be stockpiled at locations designated by the Contracting Officer. Stockpile areas shall be cleared and leveled prior to stockpiling aggregates. Aggregates shall be stockpiled to prevent segregation and contamination. Aggregates obtained from different sources shall be stockpiled separately.

3.2 NOT USED

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the drainage layer, the underlying course shall be cleaned of all foreign materials. During construction, the underlying course shall contain no frozen material. The underlying course shall conform to Section 02721 SUBBASE COURSES. Ruts or soft yielding spots in the underlying courses having inadequate compaction and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line, and grade, and recompacting to specified density. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the drainage layer is placed.

3.4 TRANSPORTING MATERIAL

3.4.1 Aggregate Drainage Layer Material

Aggregate drainage layer material shall be transported to the site in a manner which prevents segregation and contamination of materials.

3.5 PLACING

3.5.1 General Requisites

Drainage layer material shall be placed on the underlying course in lifts of uniform thickness using equipment meeting the requirements of paragraph EQUIPMENT. When a compacted layer 150 mm or less in thickness is required, the material shall be placed in a single lift. When a compacted layer in excess of 150 mm is required, the material shall be placed in lifts of equal thickness. No lift shall exceed 150 mm or be less than 75 mm when compacted. The lifts when compacted after placement shall be true to the grades or levels required with the least possible surface disturbance. Where the drainage layer is placed in more than one lift, the previously constructed lift shall be cleaned of loose and foreign material. Such adjustments in placing procedures or equipment shall be made to obtain true grades and minimize segregation and degradation of the drainage layer material. Choke stone used to stabilize the surface of the OGM shall be spread in a thin layer no thicker than 13 mm.

3.5.2 NOT USED

3.5.3 NOT USED

3.5.4 Hand Spreading

In areas where machine spreading is impractical, drainage layer material shall be spread by hand. The material shall be spread uniformly in a loose layer to prevent segregation. The material shall conform to the required grade and thickness after compaction.

3.6 COMPACTION REQUIREMENTS

Compaction shall be accomplished using rollers meeting the requirements of paragraph EQUIPMENT and operating at a rolling speed of no greater than 2.4 km per hour. Each lift of drainage material, including shoulders when specified under the shoulders, shall be compacted with the number of passes of the roller as specified by the Contracting Officer. In addition, a minimum field dry density, as specified by the Contracting Officer, shall be maintained. If the required field dry density is not obtained, the number of roller passes shall be adjusted in accordance with paragraph DEFICIENCIES. Excessive rolling resulting in crushing of aggregate particles shall be avoided. Choke stone used to stabilize the surface of the OGM shall be worked into the surface of the OGM by two passes of a vibratory roller and wetting. Compaction of bituminous stabilized material shall begin immediately when the material has cooled to 77 degreed C. Not more than 30 minutes shall elapse between the start of moist mixing of cement stabilized material and the start of field compaction and field compaction shall be completed within 60 minutes. In all places not accessible to the rollers, the drainage layer material shall be compacted with mechanical hand operated tampers.

3.7 NOT USED

3.8 FINISHING

The top surface of the drainage layer shall be finished after final compaction as determined from the test section. Adjustments in rolling and finishing procedures shall be made to obtain grades and minimize segregation and degradation of the drainage layer material.

3.9 EDGES OF DRAINAGE LAYER

Shoulder material shall be placed along the edges of the drainage layer course in a quantity that will compact to the thickness of the layer being constructed. When the drainage layer is being constructed in 2 or more lifts, at least a 300 mm width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each lift of the drainage layer.

3.10 SMOOTHNESS TEST

The surface of the top lift shall not deviate more than 10 mm when tested with a 3.66 m straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding 10 mm shall be corrected in accordance with paragraph DEFICIENCIES.

3.11 THICKNESS CONTROL

The completed thickness of the drainage layer shall be within 13 mm of the thickness indicated. Thickness shall be measured at intervals providing at least one measurement for each 500 square meters of drainage layer. Measurements shall be made in test holes at least 75 mm in diameter. Where the measured thickness is more than 13 mm deficient, such areas shall be corrected in accordance with paragraph DEFICIENCIES. Where the measured thickness is 13 mm more than indicated, it will be considered as conforming to the requirements plus 13 mm, provided the surface of the drainage layer is within 13 mm of established grade. The average job thickness shall be the average of all job measurements as specified above but within 8 mm of

the thickness shown on the drawings.

3.12 DEFICIENCIES

3.12.1 Grade and Thickness

Deficiencies in grade and thickness shall be corrected so that both grade and thickness tolerances are met. Thin layers of material shall not be added to the top surface of the drainage layer to meet grade or increase thickness. If the elevation of the top of the drainage layer is more than 13 mm above the plan grade it shall be trimmed to grade and finished in accordance with paragraph FINISHING. If the elevation of the top surface of the drainage layer is 13 mm or more below the required grade, the surface of the drainage layer shall be scarified to a depth of at least 75 mm, new material shall be added, and the layer shall be blended and recompacted to bring it to grade. Where the measured thickness of the drainage layer is more than 13 mm deficient, such areas shall be corrected by excavating to the required depth and replaced with new material to obtain a compacted lift thickness of at least 75 mm. The depth of required excavation shall be controlled to keep the final surface elevation within grade requirements and to preserve layer thicknesses of materials below the drainage layer.

3.12.2 Density

Density shall be considered deficient if the field dry density test results are below the dry density specified by the Contracting Officer. If the densities are deficient, the layer shall be rolled with 2 additional passes of the specified roller. If the dry density is still deficient, work will be stopped until the cause of the low dry densities can be determined by the Contracting Officer.

3.12.3 Smoothness

Deficiencies in smoothness shall be corrected as if they are deficiencies in grade or thickness. All tolerances for grade and thickness shall be maintained while correcting smoothness deficiencies.

-- End of Section --

SECTION 02720

STORM-DRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 304	(1994) Poly(Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter

.

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA-03	(1994) Manual for Railway Engineering (Fixed Properties): Chapter 1, Roadway and Ballast

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 444	(1989) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Storm Sewer and Drainage Pipe
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 716	(1995) Ductile Iron Culvert Pipe
ASTM B 26	(1996) Aluminum-Alloy Sand Castings
ASTM C 76	(1995) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(1996a) Mortar for Unit Masonry
ASTM C 425	(1995) Compression Joints for Vitrified Clay Pipe and Fittings

ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1994) Precast Reinforced Concrete Manhole Sections
ASTM C 506	(1995) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 507	(1995a) Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 789	(1994) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 850	(1994) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Ft. of Cover Subjected to Highway Loadings
ASTM C 877	(1994) External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate

	in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(1993) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 679	(1995) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	(1994) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1995a) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Pipeline Testing; FIO. Hydrostatic Test on Watertight Joints; FIO. Determination of Density; FIO. Frame and Cover for Gratings; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Gasket materials and plastic materials shall be protected from exposure to the direct sunlight over extended periods.

1.4.2 Handling

Materials shall be handled in such a manner as to ensure delivery to the

trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class III.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

ASTM C 506, Class A-III.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

ASTM C 507. Horizontal elliptical pipe shall be Class HE-III. Vertical elliptical pipe shall be Class VE-III.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 Ductile Iron Culvert Pipe

ASTM A 716.

2.1.8 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe in accordance with AASHTO M 304, shall be submitted prior to installation of the pipe.

2.1.8.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.9 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.9.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 80 to 600 mm in diameter and maximum DR of 26 for pipes 650 to 1200 mm in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.9.2 NOT USED

2.1.9.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

		Minimum Moment Of Inertia of Wall Section (mm to the 4th/mm)	
Nominal Size (mm)	Minimum Wall Area (square mm/m)	Cell Class 334433C	Cell Class 335434C
450	6300	850	620
525	8800	1150	840
600	9900	1330	970
675	12500	2050	1490
750	12500	2050	1490
825	14800	2640	2160
900	17100	3310	2700
1050	16500	4540	3720
1200	18700	5540	4540

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 444.

2.2.2 Precast Reinforced Concrete Box

For highway loadings with 600 mm of cover or more or subjected to dead load only, ASTM C 789; for less than 600 mm of cover subjected to highway loading, ASTM C 850.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 24 MPa concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 37.5 mm. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 25 mm thick for covers and not less than 40 mm thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 75 mm between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 NOT USED

2.3.4 NOT USED

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 NOT USED

2.3.7 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3.8 Joints

2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal

diameter of the pipe being gasketed exceeds 1.35 m.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished if specifically approved.

2.3.8.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877.

2.3.8.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 178 mm wide and approximately 9.5 mm thick, meeting the requirements of ASTM D 1056, Type 2 B3, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 20.6 mm in diameter for pipe diameters of 914 mm or smaller and 22.2 mm in diameter for larger pipe having 12.7 mm deep end corrugation. Rubber O-ring gaskets shall be 34.9 mm in diameter for pipe having 25 mm deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

2.3.8.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.8.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.8.6 NOT USED

2.3.8.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

2.3.8.8 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 3.66 m. These ladders will be not less than 406 mm in width, with 19 mm diameter rungs spaced 305 mm apart. The two stringers shall be a minimum 9.5 mm thick and 63.5 mm wide. Ladders and inserts shall be galvanized

after fabrication in conformance with ASTM A 123.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48, Class 30B or 35B. Shape and size shall be as indicated.

2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.6.1 Concrete, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to ASTM C 443. Test requirements for joints in clay pipe shall conform to ASTM C 425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches and for appurtenances and backfilling for culverts and storm drains shall be in accordance with the applicable portions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 450 mm to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing where required shall be placed within the trench width as specified. Care shall be taken not to overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 NOT USED

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded carefully in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type of joint.

3.2.2 NOT USED

3.2.3 NOT USED

3.2.4 Ductile Iron Pipe

Bedding for ductile iron pipe shall be as shown on the drawings.

3.2.5 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to the direct sunlight prior to laying as needed to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed plastic pipe shall not exceed 4.5 percent of the nominal inside diameter. After backfilling has been completed, the Government may perform a deflection test on the entire length of installed plastic pipeline using a mandrel or other suitable device. Any plastic pipe showing deflections in excess of 4.5 percent shall be removed and replaced at the Contractor's expense. All pipe in place shall be inspected before backfilling, and those pipes damaged during placement shall be removed and replaced.

3.3.1 Concrete, PVC, Ribbed PVC and Ductile Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

Placement shall be so that the manufacturer's reference lines designating the top of the pipe will be within 5 degrees of a vertical plane through the longitudinal axis of the pipe. In all backfilling operations, care shall be taken to prevent damage to or misalignment of the pipe.

3.3.3 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.4 NOT USED

3.3.5 NOT USED

3.3.6 NOT USED

3.3.7 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 1 meter apart, whichever is less.

3.3.8 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Vol. I, Chapter 8 of AREA-03.

3.4 JOINTS

3.4.1 Concrete Pipe

3.4.1.1 NOT USED

3.4.1.2 NOT USED

3.4.1.3 NOT USED

3.4.1.4 NOT USED

3.4.1.5 NOT USED

3.4.1.6 NOT USED

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, or precast reinforced concrete, complete with frames and covers or gratings and with fixed galvanized steel ladders where indicated.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 1.83 m vertically, and shall be so installed as to provide at least 152 mm of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 150 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 300 mm above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 100 millimeters. Tests for density will be made as necessary to ensure conformance to the compaction requirements specified elsewhere in this paragraph. Where it is necessary in the opinion of the Contracting Officer, any sheeting or portions of bracing used shall be left in place and the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified elsewhere in this paragraph. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 150 mm in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 300 mm above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 m, whichever is less. After the backfill has reached at least 300 mm above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 100 mm.

3.7.3 Movement of Construction Machinery

In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density (densities) which will be determined as specified in this paragraph.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the

moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

Lines shall be tested for leakage by exfiltration tests. Prior to testing for leakage the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 600 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.98 liters per mm in diameter per kilometers of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

-- End of Section --

SECTION 02721

SUBBASE COURSES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29	(1991a) Unit Weight and Voids in Aggregate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 NOT USED

1.3 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557. In this specification, degree of compaction shall be a percentage of laboratory maximum density.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; FIO.

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-09 Reports

Sampling and Testing; G.
Copies of initial and in-place test results.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved testing laboratory in accordance with Section 01440 CONTRACTOR QUALITY CONTROL. Tests shall be performed at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136 and ASTM D 422. Sieves shall conform to ASTM E 11.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture shall be determined in accordance

with ASTM D 1557.

1.5.2.4 Density Tests

Density shall be field measured in accordance with ASTM D 1556. The base plate, as shown in the drawing shall be used or ASTM D 2922. The calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and, when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D 2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.

1.5.2.5 Wear Test

Wear tests shall be made on subbase course material in conformance with ASTM C 131.

1.5.2.6 Weight of Slag

Weight per cubic meter of slag shall be determined in accordance with ASTM C 29 on the subbase course material.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation.

a. Sieve Analysis including 0.02 mm size material
b. Liquid limit and plasticity index moisture-density relationship

1.5.3.2 In-Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted subbase course. Samples shall be taken for each 200 square meters of each layer of material placed in each area.

a. Sieve Analysis including 0.02 mm size material
b. Field Density
c. Moisture liquid limit and plasticity index

1.5.4 Approval of Material

The source of the material shall be selected 14 days prior to the time the material will be required in the work. Approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted subbase course.

1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 2

degrees C. When the temperature falls below 2 degrees C, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.7 EQUIPMENT

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Subbase Course

Aggregates shall consist of crushed stone or slag, gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the 4.75 mm sieve shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested as specified in ASTM C 131. Aggregate shall be reasonably uniform in density and quality. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 1050 kg/cubic meter. Aggregates shall have a maximum size of 25 mm and shall be within the limits specified as follows:

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3	No.4
2 mm	50	80	--	85
0.075 mm	15	15	15	15

Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested as determined in accordance with ASTM D 422. The portion of any blended component and of the completed course passing the 0.425 mm shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

All clearing, stripping and excavating work involved in the opening or operation of aggregate sources shall be performed by the Contractor. Aggregate sources shall be opened to working depth in a manner that produces excavation faces that are as nearly vertical as practicable for the materials being excavated. Materials excavated from aggregate sources shall be obtained in successive cuts extending through all exposed strata. All pockets or strata of unsuitable materials overlying or occurring in the deposit shall be wasted as directed. The methods of operating aggregate

sources and the processing and blending of the material may be changed or modified by the Contracting Officer, when necessary, in order to obtain material conforming to specified requirements. Upon completion of work, aggregate sources on Government reservations shall be conditioned to drain readily, and shall be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws and authorities.

3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the subbase course, the underlying course or subgrade shall be cleaned of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Ruts, or soft yielding spots, in the underlying courses, subgrade areas having inadequate compaction, and deviations of the surface from the specified requirements, shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the subbase course. Stabilization shall be accomplished by mixing subbase-course material into the underlying course, and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements for the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the subbase course is placed.

3.4 GRADE CONTROL

The finished and completed subbase course shall conform to the lines, grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the work site.

3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the subbase material at the water content specified. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

3.6 LAYER THICKNESS

The compacted thickness of the completed course shall be as indicated. When a compacted layer of 150 mm is specified, the material may be placed in a single layer; when a compacted thickness of more than 150 mm is

required, no layer shall exceed 150 mm nor be less than 75 mm when compacted.

3.7 COMPACTION

Each layer of the subbase course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer is compacted through the full depth to at least 97 percent of laboratory maximum density. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory subbase course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.8 PROOF ROLLING

Areas designated on the drawings to be proof rolled shall receive an application of 6 coverages with a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 13.6 metric tons and inflated to a minimum of 1.035 MPa. A coverage is defined as the application of one tire print over the designated area. In the areas designated, proof rolling shall be applied to the top layer of the subbase course. Water content of the top layer of the subbase course shall be maintained such that the water content is within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. Any material in the subbase courses or underlying materials indicated to be unsatisfactory by the proof rolling shall be removed, dried, and recompacted, or removed and replaced with satisfactory materials.

3.9 EDGES

Approved material shall be placed along the edges of the subbase course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 300 mm width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the subbase course, as directed.

3.10 SMOOTHNESS TEST

The surface of each layer shall not show deviations in excess of 10 mm when tested with a 3.6 m (12 foot) straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting, as directed.

3.11 THICKNESS CONTROL

The completed thickness of the subbase course shall be in accordance with the thickness and grade indicated on the drawings. The thickness of each course shall be measured at intervals providing at least one measurement

for each 400 square meters or part thereof of subbase course. The thickness measurement shall be made by test holes, at least 75 mm in diameter through the course. The completed subbase course shall not be more than 13 mm deficient in thickness nor more than 13 mm above or below the established grade. Where any of these tolerances are exceeded, the Contractor shall correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 13 mm or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 13 mm.

3.12 MAINTENANCE

The subbase course shall be maintained in a satisfactory condition until accepted.

-- End of Section --

SECTION 02722

GRADED, CRUSHED AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1993) Moisture-Density Relations of Soils Using a 10-lb. (4.54 kg) Rammer and an 18-in (457 mm) Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1991a) Unit Weight and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes
ASTM E 548	(1994) General Criteria Used for Evaluating Laboratory Competence

1.2 NOT USED

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Sampling and testing; GA.

Copies of field test results.

1.5 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D. This will be abbreviated herein after as percentage of laboratory maximum density.

1.6 EQUIPMENT

1.6.1 Approval

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as indicated.

1.6.2 Weather Limitation

Base courses shall be placed when the atmospheric temperature is above 2 degrees C. Areas of completed base course that are damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirement.

1.7 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor, subject to approval. If the Contractor elects to establish its own testing facilities, approval of such facilities shall be based on compliance with ASTM E 548, and work requiring testing will not be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections, required because of failure of the first inspection, shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. The materials shall be tested to establish compliance with the specified requirements. Copies of test results shall be furnished to the Contracting Officer.

1.7.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests

shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.7.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.7.2.1 Sieve Analyses

Sieve analyses shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.7.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.7.2.3 Density Tests

Density shall be measured in the field in accordance with ASTM D 1556. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used.

1.7.2.4 Soundness Test

Soundness tests shall be made in conformance with ASTM C 88.

1.7.2.5 Wear Test

Wear tests shall be made in conformance with ASTM C 131.

1.7.3 Approval of Material

The source of the material to be used for producing aggregates shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of the source will be based on an inspection by the Contracting Officer. Tentative approval of material will be based on tests of samples for the specific job. Final approval of both the source and the material will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted subbase course.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of crushed stone, crushed slag, or crushed gravel, and screenings. The Contractor shall obtain materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein, after compaction and proof-rolling operations have been completed. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 1050 kg per cubic meter as determined by ASTM C 29/C 29M. The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings. The portion retained on the 4.75 mm sieve shall be known as coarse aggregate; that portion passing the 4.75 mm sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregates

Coarse aggregates shall be angular particles of uniform density. The coarse aggregate shall have a loss not greater than 25 percent weighted averaged at 5 cycles when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The coarse aggregate shall have a percentage of wear not to exceed 40 after 500 revolutions as determined by ASTM C 131. The percentage of flat and/or elongated particles shall not exceed 20 in the fraction retained on the 13 mm sieve and in the fraction passing the 13 mm sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having 2 or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the plane. When 2 fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as 2 fractured faces.

2.1.2 Fine Aggregate

Fine aggregate shall be angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. Fine aggregate shall be manufactured from gravel particles 95 percent of which by weight are retained on the 13 mm sieve.

2.1.3 Gradation Requirements

Gradation requirements specified shall apply to the completed base course. The aggregates shall have a maximum size of 25 mm and be graded continuously within the limits specified in TABLE I. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 2
50.0 mm	__
37.5 mm	100
25 mm	60-100
12.5 mm	30-65
4.75 mm	20-50
2 mm	15-40
0.425 mm	5-25
0.075 mm	0-10

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific

gravities are used.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements stated herein shall apply to any aggregate component that is blended to meet the required gradation and also to the aggregate in the completed base course. The portion of the aggregate passing the 0.425 mm sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall produce the quantity and quality of base course materials meeting these specification requirements in the specified time limits. Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and shall be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the crushed, aggregate base course, the underlying course shall be cleaned of all foreign substances. At the time of construction of the base course, the underlying course shall contain no frozen material. The underlying course shall conform to Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS AND AIRFIELDS. Ruts or soft, yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements specified shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the graded, crushed aggregate base course. Stabilization shall be accomplished by mixing graded, crushed aggregate base material into the underlying course and compacting by approved methods. The stabilized material shall be considered part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

3.4 GRADE CONTROL

During construction, the lines and grades, including crown and cross slope indicated for the base course, shall be maintained by means of line and grade stakes placed by the Contractor.

3.5 MIXING OF MATERIALS

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make such adjustments in mixing procedures or in equipment as may be directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to ensure a satisfactory base course meeting requirements of this specification.

3.6 PLACING

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 150 mm or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 150 mm is required, the material shall be placed in layers of equal thickness. No layer shall exceed 150 mm or be less than 75 mm when compacted. The layers, when compacted, shall be true to the grades or levels required, with the least possible surface disturbance. Where the base course is placed in more than 1 layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Adjustments in placing procedures or equipment shall be made as directed, to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to ensure an acceptable base course.

3.7 COMPACTION

3.7.1 Requirements

Each layer of base course shall be compacted to produce an average field-measured density, through the full depth, of at least 100 percent of laboratory maximum density obtained in the laboratory. Water content shall be maintained during the compaction procedure and subsequent proof rolling of designated areas. Water content shall be within plus or minus 2 percent of optimum water content, as determined from laboratory tests and as specified in density test procedures listed in paragraph SAMPLING AND TESTING. In places not accessible to the rollers, the base course material shall be compacted with mechanical tampers.

3.7.2 Finishing

The surface of top layer of base course shall be finished after final compaction, and proof rolled where required, by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of top layer of base course is 13 mm or more below the grade, the top layer of base shall be scarified to a depth of at least 75 mm, new material shall be added, and the layer shall be blended and recompacted to bring to grade. Adjustments in rolling and finishing procedures shall be made as may be directed to obtain grades, to minimize segregation and degradation of base course material, to adjust the water content, and to ensure an acceptable base course. Material found unacceptable shall be removed and replaced, as directed, with acceptable material.

3.8 PROOF ROLLING

Proof rolling of the areas designated shall be in addition to compaction

specified above and shall consist of application of 6 coverages with a heavy pneumatic-tired roller having 4 tires abreast, with each tire loaded to 9.1 metric tons and tires inflated to 0.620 MPa. In the areas designated, proof rolling shall be applied to the top lift of layer on which the base course is laid and to each layer of the base course. Water content of the lift of the layer on which the base course is placed, and of each layer of the base course, shall be maintained at optimum, or at the percentage directed, from the start of compaction to the completion of proof rolling. Materials in the base course or underlying materials indicated unacceptable by the proof rolling shall be removed and replaced, as directed, with acceptable materials.

3.9 EDGES OF BASE COURSE

Acceptable material shall be placed along the edges of the base course that will compact to the thickness of the course being constructed. When the course is being constructed in 2 or more layers, at least a 300 mm width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course, as directed.

3.10 SMOOTHNESS TEST

The surface of the top layer shall not deviate more than 10 mm when tested with a 3.05 m straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding 10 mm shall be corrected as directed.

3.11 THICKNESS CONTROL

The completed thickness of the base course shall be within 13 mm of the thickness indicated. The thickness of the base course shall be measured at intervals of one measurement for at least each 400 square meters of base course. The depth measurement shall be made by test holes at least 75 mm in diameter. Where the measured thickness of the base course is more than 13 mm deficient, such areas shall be corrected by excavating to the required depth and replacing with new material. Where the measured thickness of the base course is 13 mm more than indicated, it will be considered as conforming with the requirements plus 13 mm, provided the surface of the base course is within 13 mm of established grade. The average job thickness shall be the average of the job measurements as specified above but within 6 mm of the thickness indicated.

3.12 MAINTENANCE

The base course shall be maintained in a condition that will meet specification requirements until accepted.

-- End of Section --

SECTION 02730

SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 94	(1995) Ready-Mixed Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 270	(1995a) Mortar for Unit Masonry
ASTM C 425	(1995) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1994) Precast Reinforced Concrete Manhole Sections
ASTM C 700	(1995) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	(1990) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 972	(1982; R 1990) Test Method for Compression-Recovery of Tape Sealant
ASTM D 412	(1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 2680	(1995)Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1993) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(1993) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(1993) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3840	(1988) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1993) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1994) Polyethylene (PE) Plastic pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1995a) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1995) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1993a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for

	Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1988) Flanged Ductile-Iron Pipe with Threaded Flanges
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325M	(1991) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1990) Identification of the Fire Hazards of Materials

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 1.5 m outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Force mains and inverted siphons are specified in Section 02732 FORCE MAINS AND INVERTED SIPHONS; SEWER. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Portland Cement; FIO.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Oil Resistant Material.

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans are oil resistant.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 NOT USED

2.1.2 Plastic Pipe

Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite sewer piping shall conform to ASTM D 2680. Size 200 mm through 380 mm diameter.

2.1.2.1 ABS Pipe

ASTM D 2751.

2.1.2.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 380 mm or less in diameter. ASTM F 949 for corrugated sewer pipes with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 200 mm through 1200 mm diameters. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

2.1.2.3 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 450 mm through 3000 mm. ASTM F 714, size 100 mm through 1200 mm. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills.

2.1.3 Reinforced Plastic Mortar Pipe (RPMP)

ASTM D 3262.

2.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

ASTM D 3262.

2.1.4.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 1.03 MPa at 22.8 degrees C. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.4.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.1.5 Ductile Iron Pipe

Pipe shall conform to AWWA C151 unless otherwise shown or specified.

2.1.6 NOT USED

2.1.7 Clay Pipe

ASTM C 700 Extra strength.

2.2 FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 NOT USED

2.2.2 Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

2.2.2.1 ABS Pipe

ASTM D 2751.

2.2.2.2 PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

2.2.2.3 High Density Polyethylene Pipe

ASTM F 894.

2.2.3 RPMP

ASTM D 3840.

2.2.4 RTRP

ASTM D 3262.

2.2.5 Ductile Iron Pipe

Mechanical fittings shall conform to AWWA C110, rated for 1.03 MPa. Push-on fittings shall conform to AWWA C110and AWWA C111, rated for 10.3 MPa.

2.2.6 NOT USED

2.2.7 Clay Pipe

ASTM C 700 Extra strength.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions. Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as oil resistant.

2.3.1 NOT USED

2.3.2 Plastic Pipe

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

2.3.2.1 ABS Pipe

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 300 mm or less in diameter, dimensions and tolerances in accordance with Table 2 therein.

2.3.2.2 High Density Polyethylene Pipe

Rubber gasket joints shall conform to ASTM C 443.

2.3.3 RPMP

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.3.4 RTRP

Joints shall be bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.3.5 Ductile Iron Pipe

Push-on joints shall conform to AWWA C111. Mechanical joints shall conform to AWWA C111 as modified by AWWA C151. Flanged joints shall conform to AWWA C115.

2.3.6 NOT USED

2.3.7 Clay Pipe

Compression joints shall conform to ASTM C 425.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent

cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers shall be cast iron, or ductile iron. Cast iron frames and covers shall be as indicated or shall be of type as suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.6 STEEL LADDER

A steel ladder shall be provided where the depth of a manhole exceeds 3.6 m. The ladder shall not be less than 406.4 mm in width, with 19.1 mm diameter rungs spaced 304.8 mm apart. The two stringers shall be a minimum 9.5 mm thick and 50.8 mm wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123.

2.7 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.7.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.7.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 28 MPa at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 17 MPa minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.8 STRUCTURES

2.8.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the

drawings, the sewer shall not be closer horizontally than 3 m to a water-supply main or service line, except that where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, the horizontal spacing may be a minimum of 2 m. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 3 m on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 1 m to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 100 mm.

3.1.1.2 Roads, Railroads, and Airfields

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, the pipe sleeve shall be as specified for storm drains in Section 02720 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 50 mm between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with the corrosion protection as required for the conditions encountered at the site of installation.

3.1.1.3 Structures

Where sewer pipe is to be installed within 1 m of an existing or proposed building or structural foundation such as a retaining wall, or any similar structure, the sewer pipe shall be sleeved as specified above. Care shall be exercised and proper precautions taken during installation of the sewer pipe and sleeve to assure that there will be no damage to such structures and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall and the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.

d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.

e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. All required precautions shall be taken to assure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Caulked Joints

The packing material shall be well packed into the annular space to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of 25 mm after caulking.

3.1.2.2 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install at no additional cost to the Government such concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.5 Joints

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.6 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325M.

3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints

uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 600 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 50 mL per 5 mm diameter per 100 meters of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 92.5 percent of the inside diameter of the pipe, but 95 percent for RPMP and RTRP. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4.0 degrees C, and shall have a surface brinell hardness of not less than 150. It shall be center bored and through bolted with a 6.4 mm minimum diameter steel shaft having a yield strength of 480 MPa or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer such that a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be so spaced that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe, or 5 percent for RTRP and RPMP, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be encased in concrete where indicated or directed.

3.3 WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 MANHOLES

3.4.1 General

Manholes shall be constructed of concrete, or precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 100 mm per meter nor more than 200 mm per meter. Free drop inside the manholes shall not exceed 500 mm, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels, and drop manholes shall be constructed whenever the free drop would otherwise be greater than 500 mm.

3.4.2 Steel Ladder

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 1850 mm apart vertically, and shall be installed to provide at least 150 mm of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.4.3 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic

adhesive on one side.

3.4.4 Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 50 mm higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.4.5 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 50 mm adjusting rings. The bottom section will be 305 mm in height. A 152 mm high top section will cover up to two, 50 mm adjusting rings. A 305 mm high bottom section will cover up to six, 50 mm adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 50 mm and shall be overlapped by the top section by 50 mm.

3.5 CONNECTIONS TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made in such manner that the finish work will conform as nearly as practicable to the essential applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1-1/2 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 1.5 m outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 1.5 m from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

SECTION 02732

FORCE MAINS AND INVERTED SIPHONS; SEWER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(1994) Specification for Pipeline Valves (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM D 1785	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2122	(1990) Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D 2464	(1993) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1990) Heat-Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM D 3035	(1993) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
ASTM D 3139	(1989; R 1995) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM D 3350	(1993) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 4101	(1995a) Propylene Plastic Injection and Extrusion Materials
ASTM F 477	(1993) Elastomeric Seals (Gaskets) for

Joining Plastic Pipe

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings, Classes 150 and 300

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C200	(1991) Steel Water Pipe 6 In. (150 mm) and Larger
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
AWWA C210	(1992) Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C500	(1993) Gate Valves for Water and Sewerage Systems
AWWA C508	(1982; C508a) Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Hydrostatic Tests; GA.

Copies of test results.

1.3 DELIVERY AND STORAGE

All material delivered and stored shall be handled and stored in such a manner that pipe, fittings and accessories, and pipe coatings are not damaged.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Piping for force mains less than 100 mm in diameter shall be galvanized steel, polyvinyl chloride (PVC) plastic, polyethylene (PE) plastic or polypropylene plastic. Piping less than 100 mm in diameter inside pump stations shall be galvanized steel. Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 NOT USED

2.1.2 Plastic Pipe

2.1.2.1 Polyethylene (PE) Pipe

ASTM D 3350 and ASTM D 3035, minimum pressure rating of 689 kPa at 23 degrees C.

2.1.2.2 Polypropylene Pipe

ASTM D 2122 and ASTM D 4101.

2.1.2.3 Polyvinyl Chloride (PVC) Pipe

a. PVC Pipe and Fittings Less Than 100 mm Diameter: ASTM D 1785, Schedule 40, or D2241, SDR 21, with screw joints, push-on joints, or solvent weld joints.

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 Steel Pipe

a. Steel Pipe Less Than 150 mm Diameter: ASTM A 53, standard weight, threaded end, galvanized.

b. Fittings Less Than 150 mm Diameter: ASME B16.3, galvanized.

2.2 JOINTS

2.2.1 PE Pipe

a. Heat Fusion Joints: ASTM D 2657.

b. Flanged Joints: ASME B16.1 or AWWA C207.

c. Mechanical Joints: ASME B16.1.

2.2.2 Polypropylene Pipe

Heat Fusion Joints: ASTM D 2657.

2.2.3 PVC Pipe

a. Screw Joint Fittings: ASTM D 2464, Schedule 80.

b. Push-On Joint Fittings: ASTM D 3139, with ASTM F 477gaskets.

c. Solvent Cement: ASTM D 2564.

d. Couplings for use with plain end pipe shall have centering rings or stops to ensure the coupling is centered on the joint.

2.2.4 NOT USED

2.2.5 Steel Pipe

a. Push-on Joints: AWWA C200.

b. Mechanical Joints: AWWA C200.

c. Flanged Joints: AWWA C207.

2.3 VALVES

2.3.1 Gate Valves

Gate valves 80 mm and larger shall comply with AWWA C500. Valves for buried service shall be non-rising stem (NRS), 50 mm square nut operated with joints applicable to the pipe or installation. Buried valves shall be furnished with extension stems comprising socket, extension stem and operating nut, and shall be of an appropriate length to bring operating nut to within 150 mm of grade. One 1200 mm "T" handle valve wrench shall be furnished for each quantity of 6 buried valves. Gate valves that are exposed or installed inside shall be outside screw and yoke (OS&Y), handwheel operated with flange ends unless otherwise indicated. Gate valve operating nuts and handwheels shall have an arrow and the word "OPEN" cast in raised letters to indicate the direction of opening.

2.3.2 Check Valves

Check valves shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 1034 kPa or as indicated. The body shall be iron. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body.

a. Ball Check Valves shall be iron body, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type complying with ASME B16.1. Ball shall be stainless steel unless otherwise specified.

b. Swing Check Valves shall comply with AWWA C508 and shall be iron body, bronze mounted, and shall have flanged ends. Flanges shall be the Class 125 type complying with ASME B16.1.

2.3.3 Plug Valves

Cast iron valves shall comply with MSS SP-78. Steel plug valves shall

comply with API Spec 6D.

2.3.4 Pinch Valves

Pinch valves shall be double acting, jam-proof type with unobstructed streamlined flows and built-in operator. The body shall be iron with a non-rising handwheel. The sleeve shall be of pure gum rubber, neoprene, Buna N or hypalon as required for service. The valve shall have flanged ends. Flanges shall be of the Class 125 type complying with ASME B16.1.

2.3.5 Air Release Valves

Air release valves shall be designed to permit release of air from an empty pipe during filling and shall be capable of discharging accumulated air in the line while the line is in operation and under pressure. Valves shall be attached by means of threaded pipe connections. Valves shall be vented to the atmosphere.

a. Manual Air Release Valves: Manual air release valves shall consist of a 80 mm gate valve and 80 mm ductile iron pipe and fittings. The valve shall be installed with its line of flow in the horizontal position.

b. Automatic Air Release Valve: Automatic air release valves shall be of the compound lever type capable of withstanding operating pressures of 1034 kPa. The valves shall have a 13 mm outlet. The body and cover of the valve shall be of iron with a stainless steel float. All internal parts shall be stainless steel or bronze. The valve shall be specifically adapted for use with sewage. Each valve shall be complete with hose and blow-off valves to permit backflushing without dismantling the valve.

2.4 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subject to vehicular traffic. Cast iron boxes shall be the extension type with slide type adjustment and with flared base. The minimum thickness of metal shall be 5 mm. The box length shall be adaptable, without full extension, to the depth of cover over the pipe at the valve locations. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "SEWER" shall be cast in the cover.

2.5 NOT USED

2.6 MISCELLANEOUS MATERIALS

Miscellaneous materials shall comply with the following requirements:

2.6.1 Pipe Coatings and Linings

a. Steel, interior: AWWA C203 or AWWA C210.

b. Steel, exterior, buried: AWWA C203.

c. Steel, exterior, exposed: AWWA C210.

2.6.2 Joint Lubricants

Joint lubricants shall be as recommended by the pipe manufacturer.

2.6.3 Bolts, Nuts and Glands

AWWA C111.

2.6.4 Joint Compound

A stiff mixture of graphite and oil or inert filler and oil.

2.6.5 Joint Tape

ASTM D 3308.

2.6.6 Bond Wire

Bond wire type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe, pipe fittings, and appurtenances shall be installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.1.1 Adjacent Facilities

Installation of force mains near adjacent facilities shall be as specified in Section 02730 SANITARY SEWERS.

3.1.2 Cutting

Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practicable. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying.

3.1.3 Laying

Except where otherwise authorized, pipe shall be laid with bells facing the direction of laying. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with the following:

a. Steel: AWWA C600.

b. Polyvinyl Chloride: Manufacturer's instructions.

c. Polyethylene: ASTM D 2774.

d. Polypropylene: ASTM D 2774.

3.1.4 Jointing

3.1.4.1 NOT USED

3.1.4.2 Polyethylene Pipe

Heat fusion joints shall comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time. Flanged and mechanical joints shall be made in compliance with the manufacturer's instructions.

3.1.4.3 Polypropylene Pipe

Heat fusion joints shall comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time.

3.1.4.4 Polyvinyl Chloride Pipe

a. Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joint shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

b. Push-on joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

c. Solvent-weld joints shall comply with the manufacturer's instructions.

3.1.4.5 NOT USED

3.1.4.6 NOT USED

3.1.4.7 NOT USED

3.1.4.8 Steel Pipe

Screw joints shall be made tight with joint tape or joint compound applied with a brush to the male threads only. Installation of mechanical joints, push-on joints, and flanged joints shall comply with the manufacturer's instructions.

3.1.5 Coating and Lining

Field coating of non-galvanized steel pipe shall comply with AWWA C203. The applied materials shall be tested by means of a spark-type electrical device in compliance with AWWA C203. Flaws and holidays in the coating or lining of the pipe and the pipe joints shall be repaired such that the repaired areas will be at least equal in thickness to the minimum required for the pipe.

3.1.6 NOT USED

3.1.7 Valves

Prior to installation, valves shall be cleaned of all foreign matter and inspected for damage. Valves shall be fully opened and closed to ensure that all parts are properly operating. Valves shall be installed with the stem in the vertical position.

3.1.8 Valve Boxes

Valve boxes shall be installed over each outside gate valve, unless otherwise indicated. Valve boxes shall be centered over the valve. Fill shall be carefully tamped around each valve box to a distance of 1.2 m on all sides or to undisturbed trench face, if less than 1.2 m.

3.1.9 NOT USED

3.1.10 Drain Lines

Drain lines shall be installed where indicated. The drain line shall consist of a tee in the main line with a 100 mm diameter branch, a 100 mm diameter elbow, and a 100 mm gate valve.

3.1.11 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, shall be provided with thrust restraint. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be thrust blocks.

3.1.11.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.12 NOT USED

3.1.13 Bonded Joints

Where indicated, a metallic bond shall be provided at each joint, including joints made with flexible couplings or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond shall be of the thermal-weld type.

3.2 HYDROSTATIC TESTS

The pipeline shall be subjected to both a pressure test and a leakage test. The method proposed for disposal of waste water from hydrostatic tests shall be approved by the Contracting Officer. Testing shall be performed by an approved independent testing laboratory or by the Contractor subject to approval. The test may be witnessed by the Contracting Officer. The Contracting Officer shall be notified at least 7 days in advance of equipment tests. The final test report shall be delivered to the Contracting Officer within 30 days of the test.

3.2.1 Pressure Test

After the pipe has been installed, joints completed, thrust blocks have been in place for at least five days, and the trench has been partially backfilled, leaving the joints exposed for examination, the pipe shall be filled with water in a manner to expel all air. The pipeline shall be subjected to a test pressure of 700 kPa or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Each valve shall be opened and closed several times during the test. The exposed pipe, joints, fitting, and valves shall be examined for leaks. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve shall be replaced.

3.2.2 Leakage Test

The leakage test may be conducted subsequent to or concurrently with the pressure test. The amount of water permitted as leakage for the line shall be placed in a sealed container attached to the supply side of the test pump. No other source of supply will be permitted to be applied to the pump or line under test. The water shall be pumped into the line by the test pump as required to maintain the specified test pressure as described for pressure test for a 2-hour period. Exhaustion of the supply or the inability to maintain the required pressure will be considered test failure. Polyethylene pipe can experience diametric expansion and pressure elongation during initial testing. The manufacturer shall be consulted prior to testing for special testing considerations. Allowable leakage shall be determined by the following formula:

$L = NDP/K$ Where:

L = Allowable leakage in gallons per hour.

N = Number of joints in length of pipeline tested.

D = Nominal diameter of the pipe in inches.

P = Square root of the test pressure in psig.

K = 7400 for pipe materials.

At the conclusion of the test, the amount of water remaining in the container shall be measured and the results recorded in the test report.

3.2.3 Retesting

If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted until the results of the tests are within specified allowances without additional cost to the Government.

-- End of Section --

SECTION 02748

BITUMINOUS TACK AND PRIME COATS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 40	(1978; R 1983) Sampling Bituminous Materials

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 2995	(1993) Determining Application Rate of Bituminous Distributors

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT	Virginia Department of Transportation Standard Specifications

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Tests; FIO.

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.4 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.4.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.4.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.5 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 10 degrees C or above and when the temperature has not been below 2 degrees C for the 12 hours prior to application.

PART 2 PRODUCTS

2.1 TACK COAT

Cutback asphalt shall conform to the Virginia DOT Standards VDOT and approved by the Contracting Officer.

2.2 PRIME COAT

Cutback asphalt shall conform to the Virginia DOT Standards VDOT and approved by the Contracting Officer.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.20 liter nor more than 0.70 liter per square meter of

pavement surface.

3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.70 liter nor more than 1.80 liters per square meter of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm/sec, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts	
SC-250	75-132 degrees C
MC-30	29-87 degrees C
MC-70	50-107 degrees C
MC-250	75-132 degrees C
RC-70	50-90 degrees C*
RC-250	75-12 degrees C*

*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 8 meters of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed

to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material used shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 NOT USED

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

SECTION 02754
CONCRETE PAVEMENTS FOR SMALL PROJECTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1996) Standard Specification for Structural Concrete
ACI 305R	(1991) Hot Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615	(1996) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	(1996) Ready-Mixed Concrete
ASTM C 123	(1994) Lightweight Pieces in Aggregate
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1996) Portland Cement
ASTM C 192	(1990a) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 618	(1996a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral

	Admixture in Portland Cement Concrete
ASTM C 666	(1992) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 989	(1994a) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1077	(1995a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ARMY CORPS OF ENGINEERS (COE)

COE CRD-C 130	(1989) Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 300	(1990) Specifications for Membrane-Forming Compounds for Curing Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1990) Concrete Plant Standards

1.2 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete (rigid) pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

1.3 NOT USED

1.4 ACCEPTABILITY OF WORK

The pavement will be accepted on the basis of tests made by the Contractor or its suppliers, as specified herein. The Government may, at its discretion, make check tests to validate the results of the Contractor's testing. Concrete samples shall be taken for every 100 cu. m by the Contractor at the placement to determine the slump, air content, and strength of the concrete. Test cylinders shall be made for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed into service. All air content measurements shall be determined in

accordance with ASTM C 231. All slump tests shall be made in accordance with ASTM C 143. All test cylinders shall be 150 by 300 mm cylinders and shall be fabricated in accordance with ASTM C 192, using only steel molds, cured in accordance with ASTM C 31, and tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. The Contractor shall furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory.

1.4.1 Evaluation Sampling

Sampling, testing, and mixture proportioning shall be performed by a commercial Testing Laboratory, conforming with ASTM C 1077. The individuals who sample and test concrete and concrete constituents shall be certified as American Concrete Institute (ACI) Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete shall be certified as ACI Concrete Construction Inspector, Level II. All mix design, weekly quality control reports, smoothness reports, and project certification reports shall be signed by a Registered Engineer.

1.4.2 Surface Testing

When requested by the Contracting Officer, surface testing for surface smoothness, edge slump and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

1.4.2.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 3 mm or more, and all pavements shall be within the tolerances specified in Table 1 when checked with the straightedge.

TABLE 1
STRAIGHTEDGE SURFACE SMOOTHNESS--PAVEMENTS

Pavement Category	Direction of Testing	Tolerances mm
Runways and Taxiways	Longitudinal	3
	Transverse	6.5
Calibration Hardstands & Compass Swinging Bases	Longitudinal	3
	Transverse	3
All Other Airfield and Helicopter Paved Areas	Longitudinal	6.5
	Transverse	6.5

1.4.2.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to

identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 4.5 m apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface, in the area between these two high points.

1.4.3 Edge Slump Testing and Conformance

When slip-form paving is used, not more than 15 percent of the total free edge of the slipformed portion of the pavement, shall have an edge slump exceeding 6 mm and no slab shall have an edge slump exceeding 9 mm. Edge slump shall be determined as above for surface smoothness, at each free edge of each slipformed paving lane constructed. Measurements shall be made at 1.5 to 4.5 m spacings, and as directed. When edge slump exceeding the limits specified above is encountered on either side of the paving lane, additional straightedge measurements shall be made, if required, to define the linear limits of the excessive slump. The concrete for the entire width of the paving lane within these limits of excessive edge slump shall be removed and replaced. Adding concrete or paste to the edge or otherwise manipulating the plastic concrete after the sliding form has passed, or patching the hardened concrete, shall not be used as a method for correcting excessive edge slump.

1.4.4 Plan Grade Testing and Conformance

The finished surface of the pavements shall conform, within the tolerances shown in Table 1, to the lines, grades, and cross sections shown. The finished surface of new abutting pavements shall coincide at their juncture. The finished surface of airfield runway, taxiway, and apron pavements shall vary not more than 12 mm above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 18 mm above or below the plan grade line or elevation indicated. Each pavement category shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

1.5 PRECONSTRUCTION TESTING OF MATERIALS

The Contractor shall not be entitled to any additional payment or extension of time because of delays caused by sampling and testing additional sources, or samples, necessitated by failure of any samples. Aggregates shall be sampled and tested by the Test Laboratory and shall be representative of the materials to be used for the project. Test results, signed by a Registered Engineer, shall be submitted 45 days before commencing paving. No aggregate shall be used unless test results show that it meets all requirements of these specifications, including compliance with ASTM C 33 and deleterious materials limitations.

1.6 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; FIO.

Manufacturer's literature on the concrete plant; mixing equipment; hauling equipment; placing and finishing, and curing equipment; at least 7 days prior to start of paving.

SD-07 Schedules

Paving; FIO.

Paving Schedules at least 7 days prior to start of paving.

SD-08 Statements

Mixture Proportions; GA.

The report of the Contractor's mixture proportioning studies showing the proportions of all ingredients and supporting information on aggregate and other materials that will be used in the manufacture of concrete, at least 14 days prior to commencing concrete placing operations.

1.7 EQUIPMENT

1.7.1 Batching and Mixing

The batching plant shall conform to NRMCA CPMB 100, the equipment requirements in ASTM C 94, and as specified. Water shall not be weighed or measured cumulatively with another ingredient. All concrete materials batching shall meet ASTM C 94 requirements. Mixers shall be stationary mixers or truck mixers. Truck mixers shall not be used for mixing paving concrete if slipform paving is used. Batching, mixers, mixing time, permitted reduction of mixing time, and concrete uniformity shall meet the requirements of ASTM C 94, and shall be documented in the initial weekly QC Report.

1.7.2 Transporting Equipment

Transporting equipment shall be in conformance with ASTM C 94 and as specified herein. Concrete shall be transported to the paving site in rear-dump trucks, in truck mixers designed with extra large blading and rear opening specifically for low slump concrete, or in agitators. Bottom-dump trucks shall not be used for delivery of concrete.

1.7.3 Delivery Equipment

When concrete transport equipment cannot operate on the paving lane, side-delivery transport equipment consisting of self-propelled moving conveyors shall be used to deliver concrete from the transport equipment and discharge it in front of the paver. Front-end loaders, dozers, or similar equipment shall not be used to distribute the concrete.

1.7.4 Paver-Finisher

The paver-finisher shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality pavement. The paver-finisher shall spread, consolidate, and shape the plastic concrete to

the desired cross section in one pass. The paver-finisher shall be equipped with a full width "knock-down" auger, capable of operating in both directions, which will evenly spread the fresh concrete in front of the screed or extrusion plate. Immersion vibrators shall be gang mounted at the front of the paver on a frame equipped with suitable controls so that all vibrators can be operated at any desired depth within the slab or completely withdrawn from the concrete. The vibrators shall be automatically controlled so that they will be immediately stopped as forward motion of the paver ceases. The spacing of the immersion vibrators across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between vibrators shall not exceed 750 mm, and the outside vibrators shall not exceed 300 mm from the edge of the lane. The paver-finisher shall be equipped with a transversely oscillating screed or an extrusion plate to shape, compact, and smooth the surface.

1.7.4.1 Paver-Finisher with Fixed Forms

The paver-finisher shall be equipped with wheels designed to ride the forms, keep it aligned with the forms, and to spread the preventing deformation of the forms.

1.7.4.2 Slipform Paver-Finisher

The slipform paver-finisher shall be automatically controlled and crawler mounted with padded tracks. Horizontal alignment shall be electronically referenced to a taut wire guideline. Vertical alignment shall be electronically referenced on both sides of the paver to a taut wire guideline, to an approved laser control system, or to a ski operating on a completed lane. Control from a slope-adjustment control or control operating from the underlying material shall not be used.

1.7.4.3 Other Types of Finishing Equipment

Bridge deck finishers shall be used for pavements 250 mm or less in thickness, where longitudinal and transverse surface smoothness tolerances are 6.5 mm or greater. Clary screeds or other rotating tube floats will not be allowed on the project.

1.7.5 Curing Equipment

Equipment for curing is specified in paragraph CURING.

1.7.6 Texturing Equipment

Texturing equipment shall be as specified below.

1.7.6.1 Fabric Drag

A fabric drag shall consist of a piece of fabric material as wide as the lane width securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. The material shall be wide enough to provide 300 to 450 mm dragging flat on the pavement surface. The fabric material shall be clean, reasonably new burlap, kept clean and saturated during use.

1.7.6.2 Deep Texturing Equipment

Texturing equipment shall consist of a stiff bristled broom forming a drag at least 1.2 m long. This drag shall be mounted in a wheeled frame

spanning the paving lane and constructed to mechanically pull the drag in a straight line across the paving lane perpendicular to the centerline.

1.7.7 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-tip-bladed concrete saws mounted on a wheeled chassis.

1.7.8 Straightedge

The Contractor shall furnish and maintain at the job site one 4 m straightedge for testing concrete surface smoothness. The straightedge shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement or portland cement in combination with pozzolan or ground granulated blast furnace slag and shall conform to appropriate specifications listed below.

2.1.1 Portland Cement

Portland cement shall conform to ASTM C 150 Type II, low-alkali.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 Pozzolan (Fly Ash)

Fly ash shall conform to ASTM C 618 Class F, including all the supplementary optional physical requirements.

2.1.5 Ground Granulated Blast-Furnace Slag (GGBF Slag)

Ground granulated blast-furnace slag shall conform to ASTM C 989 Grade 120.

2.2 AGGREGATES

Aggregates shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C 33, including deleterious materials, abrasion loss and soundness requirements of ASTM C 33, and other requirements specified herein. Aggregate not having a satisfactory demonstrable service record shall have a durability factor of 50 or more when subjected to freezing and thawing in concrete in accordance with ASTM C 666.

2.2.1 Coarse Aggregate

Coarse aggregate shall consist of crushed gravel, crushed stone, or a combination thereof. Aggregate used for paving compass calibration hardstands shall be free of materials having magnetic properties. The nominal maximum size of the coarse aggregate shall be 25.0 mm. When the nominal maximum size is greater than 25.0 mm, the aggregates shall be

furnished in two ASTM C 33 size groups, No. 67 and No. 4. The amount of deleterious material in each size of coarse aggregate shall not exceed the limits shown in ASTM C 33 Class 1N, 4M or 4S, depending on the weathering region, and the following limits:

a. Lightweight particles 1.0 max. percent by mass (ASTM C 123).

b. Other soft particles 2.0 max. percent by mass (COE CRD-C 130).

c. Total of all deleterious 5.0 max. percent by mass (substances listed in ASTM C 33 and above, exclusive of material finer than 0.075 mm sieve).

d. The separation medium for lightweight particles shall have a density of 2.0 Mg/cubic meters.

2.2.2 Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles. Aggregate used for paving compass calibration hardstands shall be free of materials having magnetic properties. All fine aggregate shall be composed of clean, hard, durable particles meeting the requirements of ASTM C 33 and the requirements herein. The amount of deleterious material in the fine aggregate shall not exceed the limits in ASTM C 33and shall not exceed the following limits:

a. Lightweight particles (ASTM C 123) 1.0 percent max. by mass using a medium with a density of 2.0 Mg/cubic meter.

b. The total of all deleterious material types, listed in ASTM C 33 and above, shall not exceed 3.0 percent of the mass of the fine aggregate.

2.3 CHEMICAL ADMIXTURES

Air-entraining admixture shall conform to ASTM C 260. An accelerator shall be used only when specified in paragraph SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES and shall not be used to reduce the amount of cementitious material used. Accelerator shall conform to ASTM C 494Type C. Calcium chloride and admixtures containing calcium chloride shall not be used. A water-reducing or retarding admixture shall meet the requirements of ASTM C 494. Type G or H admixtures are not allowed.

2.4 CURING MATERIALS

Membrane forming curing compound shall be a white pigmented compound conforming to COE CRD-C 300. Burlap shall be new or shall be clean material never used for anything other than curing concrete.

2.5 WATER

Water for mixing and curing shall be clean, potable, and free of injurious amounts of oil, acid, salt, or alkali.

2.6 JOINT MATERIALS

2.6.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to ASTM D 1751. Expansion joint filler shall be 20 mm thick.

2.6.2 Slip Joint Material

Slip joint material shall be 6 mm thick expansion joint filler conforming to ASTM D 1751 or ASTM D 1752.

2.6.3 Contraction Joint Inserts

Sawable contraction joint inserts shall conform to COE CRD-C 540. No metal inserts of any kind shall be used.

2.7 NOT USED

2.8 DOWELS AND TIE BARS

2.8.1 Dowels

Dowels shall be single piece, plain (non-deformed) steel bars conforming to ASTM A 615 Grade 60 or higher. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight.

2.9 NOT USED

2.10 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

Specified compressive strength, f'c, for concrete is 30 MPa at 28 days. Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio is based on absolute volume equivalency, where the ratio is determined using the weight of cement for a cement only mix, or using the total volume of cement plus pozzolan converted to an equivalent weight of cement by the absolute volume equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 4 plus or minus 1 percent. The maximum allowable slump of the concrete shall be 75 mm for pavement constructed with fixed forms. For slipformed pavement, the maximum allowable slump shall be 30 mm. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 3.5 MPa. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

2.11 MIXTURE PROPORTIONS

2.11.1 Composition Concrete

Composition concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Fly ash, if used, shall be used only at a rate between 15 and 35 percent by mass of the total cementitious material. Admixtures shall consist of air entraining admixture and may also include accelerator, retarder, and water-reducing admixture. High range water-reducing admixtures and admixtures to produce flowable concrete shall not be used. No substitutions shall be made in the materials used in the mixture proportions without additional tests to show that the quality of the concrete is satisfactory.

2.11.2 Concrete Mixture Proportioning Studies

Trial design batches, mixture proportioning studies, and testing shall be the responsibility of the Contractor, and shall be performed by the Test Laboratory and signed by a Registered Engineer. No concrete pavement shall be placed until the Contracting Officer has approved the Contractor's mixture proportions. All materials used in mixture proportioning studies shall be representative of those proposed for use on the project. If there is a change in materials, additional mixture design studies shall be made using the new materials. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1. At least three different water-cementitious ratios, which will produce a range of strength encompassing that required on the project, shall be used. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content. Maximum sand content shall be 40 percent of the total aggregate SSD weight. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

2.11.3 Mixture Proportioning Procedure

The Contractor shall perform the following:

a. Fabricate, cure and test 6 test cylinders per age for each mixture at 7 and 28 days.

b. Using the average strength for each w/(c+p), plot the results from each of the three mixtures on separate graphs for w/(c+p) versus 28-day strength.

c. From the graphs select a w/(c+p) which will produce a mixture giving a 28-day strength equal to the required strength determined in accordance with the following paragraph.

2.11.4 Average Strength Required for Mixtures

In order to ensure meeting, during production, the strength requirements specified, the mixture proportions selected shall produce a required average strength, f'cr, exceeding the specified strength, f'c, in accordance with procedures in Chapter 3 of ACI 301, "Proportioning."

PART 3 EXECUTION

3.1 CONDITIONING OF UNDERLYING MATERIAL

Underlying material, subgrade and base course, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon.

3.2 WEATHER LIMITATIONS

3.2.1 Hot Weather Paving

The temperature of concrete shall not exceed 32 degrees C. Steel forms, dowels and reinforcing shall be cooled prior to concrete placement when steel temperatures are greater than 49 degrees C.

3.2.2 Cold Weather Paving

The ambient temperature of the air at the placing site and the temperature of surfaces to receive concrete shall be not less 5 degrees C. The temperature of the concrete when placed shall be not less than 10 degrees C.

Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, chemical admixture conforming to ASTM C 494Type C or E may be used provided it contains no calcium chloride. Calcium chloride shall not be used at any time. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees C for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Pavement damaged by freezing shall be completely removed and replaced at the Contractor's expense as specified in paragraph, REPAIR, REMOVAL, AND REPLACEMENT OF SLABS.

3.3 CONCRETE PRODUCTION

3.3.1 General Requirements

Concrete shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above 32 degrees C, the time shall be reduced to 30 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall show at least the mass, or volume, of all ingredients in each batch delivered, the water meter and revolution meter reading on truck mixers and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government daily.

3.3.2 Transporting and Transfer-Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. Equipment shall be allowed to operate on the underlying material only if no damage is done to the underlying material and its degree of compaction. Any disturbance to the underlying material that does occur shall be corrected before the paver-finisher reaches the location of the disturbance and the equipment shall be replaced or procedures changed to prevent any future damage. Additional water may be added to truck mixers to bring the slump within the specified range provided the mixture water-cement ratio is not exceeded.

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms or slipforms.

3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 50 mm. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Operation

When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement, including keeping the existing pavement surface free of any debris, and placing rubber mats beneath the paver tracks. Transversely oscillating screeds and extrusion plates shall overlap the existing pavement the minimum possible, but in no case more than 200 mm.

3.4.3 Required Results

The paver-finisher shall be operated to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. It shall produce only a very minimum of paste at the surface. Multiple passes of the paver-finisher shall not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing, other than the use of cutting straightedges, except in very infrequent instances. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

3.4.4 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 45 m or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 200 mm or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.5 Slipform Paving

The slipform paver shall shape the concrete to the specified and indicated cross section in one pass, and shall finish the surface and edges so that only a very minimum amount of hand finishing is required. Dowels shall not be installed by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete. If a keyway is required, a 0.45 to 0.55 mm thick metal keyway liner shall be installed as the keyway is extruded.

3.4.6 NOT USED

3.4.7 Placing Dowels

Dowels shall be installed with alignment not greater than 1 mm per 100 mm. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 15 mm and a vertical tolerance of plus or minus 5 mm. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels in joints

shall be omitted when the center of the dowel is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.7.1 NOT USED

3.4.7.2 Construction Joints-Fixed Form Paving

Installation of dowels shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.7.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 3 mm greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

3.4.7.4 Expansion Joints

Dowels in expansion joints shall be installed by the bonded-in-place method or by bonding into holes drilled in hardened concrete, using procedures specified above.

3.5 FINISHING

Clary screeds, "bridge deck" finishers, or other rotating pipe or tube type equipment shall not be permitted. The sequence of machine operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Hand finishing shall be used only infrequently and only on isolated areas of odd slab shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Equipment to be used for supplemental hand finishing shall primarily be 3 to 4 m cutting straightedges; only very sparing use of bull floats shall be allowed. At no time shall water be added to the surface of the slab in any way, except for fog (mist) sprays to prevent plastic shrinkage cracking.

3.5.1 Machine Finishing With Fixed Forms

The machine shall be designed to ride the forms. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

3.5.2 Machine Finishing With Slipform Pavers

If there is sufficient concrete slurry or fluid paste on the surface that it runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such slurry. Any slurry which does run down the vertical edges shall be immediately removed. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

3.5.3 Surface Correction

While the concrete is still plastic, irregularities and marks in the pavement surface shall be eliminated by means of cutting straightedges, 3 to 4 m in length. Depressions shall be filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. Long-handled, flat "bull floats" shall be used sparingly and only as necessary to correct minor, scattered surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished.

3.5.4 Hand Finishing

Hand finishing operations shall be used only for those unusual slabs as specified previously. Grate tampers (jitterbugs) shall not be used. As soon as placed and vibrated, the concrete shall be struck off and screeded. The surface shall be tamped with a strike-off and tamping screed, or vibratory screed. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally. Long-handled, flat bull floats shall be used sparingly and only as necessary to correct surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished. No water shall be added to the pavement during finishing operations.

3.5.5 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris. Any type of transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 13 mm of a true line. The concrete in areas of recesses for tie-down anchors, lighting fixtures, and other outlets in the pavement shall be finished to provide a surface of the same texture as the surrounding area.

3.5.5.1 Fabric-Drag Surface Finish

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with a moist fabric drag. The dragging shall produce a uniform finished surface having a fine sandy texture without disfiguring marks.

3.5.5.2 Broom Texturing

Surface texture shall be applied using a mechanical stiff bristle broom drag of a type that will uniformly score the surface transverse to the pavement center line. The broom shall be capable of traversing the full

width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. The scores should be uniform in appearance and approximately 1.5 mm in depth but not more than 3 mm in depth. Hand brooming will be permitted only on isolated odd shaped slabs or slabs where hand finishing is permitted.

3.5.6 Edging

The edges of slipformed lanes shall not be edged. After texturing has been completed, the edge of the slabs along the forms shall be carefully finished with an edging tool to form a smooth rounded surface of 3 mm radius. No water shall be added to the surface during edging.

3.6 CURING

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. Unhardened concrete shall be protected from rain and flowing water. During hot weather with low humidity and/or wind, the Contractor shall institute measures to prevent plastic shrinkage cracks from developing. ACI 305R contains means of predicting plastic shrinkage cracking and preventative measures. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry. Curing shall be accomplished by one of the following methods.

3.6.1 Membrane Curing

A uniform coating of white-pigmented membrane-forming curing compound shall be applied to the entire exposed surface of the concrete including pavement edges as soon as the free water has disappeared from the surface after finishing. If evaporation is high and no moisture is present on the surface even though bleeding has not stopped, fog sprays shall be used to keep the surface moist until setting of the cement occurs. Curing compound shall then be immediately applied. Curing compound shall be applied to the finished surfaces by means of a self-propelled automatic spraying machine, equipped with multiple spraying nozzles with wind shields, spaning the newly paved lane. The curing compound shall be applied at a maximum application rate of 5 square meters per L. The application of curing compound by hand-operated, mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs where indicated and on concrete surfaces exposed by the removal of forms. The compound shall form a uniform, continuous, cohesive film that will not check, crack, or peel and that will be free from pinholes and other discontinuities. Areas where the curing compound develops the above defects or is damaged by heavy rainfall, sawing or other construction operations within the curing period, shall be immediately resprayed.

3.6.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Impervious sheet curing shall not be used.

3.7 JOINTS

No deviation from the jointing pattern shown on the drawings shall be made without written approval of the Design District Pavement or Geotechnical Engineer. All joints shall be straight, perpendicular to the finished grade of the pavement, and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 13 mm.

3.7.1 Longitudinal Construction Joints

Dowels shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated.

3.7.2 Transverse Construction Joints

Transverse construction joints shall be installed at a planned transverse joint, at the end of each day's placing operations and when concrete placement is interrupted. Transverse construction joints shall be constructed either by utilizing headers and hand placement and finishing techniques, or by placing concrete beyond the transverse construction joint location and then saw cutting full depth and removing concrete back to the transverse construction joint location. For the latter case, dowels shall be installed using methods for dowels installed in hardened concrete described above. All transverse construction joints shall be dowelled.

3.7.3 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using preformed joint filler of the type, thickness, and width indicated, and shall extend the full slab depth. Edges of the concrete at the joint face shall be edged. The joint filler strips shall be installed to form a recess at the pavement surface to be filled with joint sealant. Expansion joints shall be constructed with dowels for load transfer.

3.7.4 Slip Joints

Slip joints shall be installed the full depth of the slab using expansion joint preformed joint filler material attached to the face of the original concrete placement. A reservoir for joint sealant shall be constructed at the top of the joint. Edges of the joint face shall be edged.

3.7.5 Contraction Joints

Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete with a power-driven saw. Transverse contraction joints shall be constructed in conformance with requirements for sawed joints.

3.7.5.1 Sawed Joints

Sawed contraction joints shall be constructed by sawing a groove in the concrete with a 3 mm blade to the indicated depth. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Sawing at a given joint

location shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. The surface shall be resprayed with curing compound as soon as free water disappears. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord or backer rod before the concrete in the region of the joint is resprayed with curing compound.

3.7.6 Thickened Edge Joints

Underlying material in the transition area shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

3.7.7 Special Joints

Special joints (undercut joints) shall be constructed adjacent to existing pavement as indicated. The concrete shall be worked under the edge of the existing pavement to completely fill the void and shall be thoroughly consolidated by the use of hand-held vibrators.

3.8 REPAIR, REMOVAL, AND REPLACEMENT OF SLABS

New pavement slabs that contain full-depth cracks shall be removed and replaced, as specified herein at no cost to the Government. Removal and replacement shall be full depth, shall be full width of the paving lane, and the limit of removal shall be from each original transverse joint . The Contracting Officer will determine whether cracks extend full depth of the pavement and may require minimum 150 mm diameter cores to be drilled on the crack to determine depth of cracking. Cores shall be drilled and the hole later filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin. Drilling of cores and refilling holes shall be at no expense to the Government. Cracks that do not extend full depth of slab shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1. The Contractor shall ensure that the crack is not widened during epoxy resin injection. Where a full depth crack intersects the original transverse joint, the slab(s) containing the crack shall be removed and replaced, with dowels installed, as required below. Spalls along joints shall be repaired as specified.

3.8.1 Removal and Replacement of Full Slabs

Unless there are keys or dowels present, all edges of the slab shall be sawcut full depth. If keys or dowels, are present along any edges, these edges shall be sawed full depth 150 mm from the edge if only keys are present, or just beyond the end of dowels if they are present. These joints shall then be carefully sawed on the joint line to within 25 mm of the depth of the dowel or key. The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. The narrow strips along keyed or doweled edges shall be carefully broken up and removed. Care shall be taken to prevent damage to the dowels, tie bars, or keys or to concrete to remain in place. Protruding portions of dowels shall be painted and lightly oiled. The joint face below keys or dowels shall be suitably trimmed so that there is no abrupt offset. If underbreak occurs at any point along any edge, the area shall be hand-filled with concrete, producing an even joint face from top to bottom, before replacing the removed slab. If underbreak over 100 mm deep occurs, the entire slab containing the underbreak shall be removed and

replaced. Where there are no dowels or keys on an edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete. Original damaged dowels shall be cut off flush with the joint face. All four edges of the new slab shall thus contain dowels or original keys. Prior to placement of new concrete, the underlying material shall be graded and recompacted, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants, and coated with a double application of membrane forming curing compound as bond breaker. Placement of concrete shall be as specified for original construction. The resulting joints around the new slab shall be prepared and sealed as specified.

3.8.2 Repairing Spalls Along Joints

Spalls along joints and cracks shall be repaired by first making a vertical saw cut at least 25 mm outside the spalled area and to a depth of at least 50 mm. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete. The cavity shall be thoroughly cleaned with high pressure water jets supplemented with compressed air to remove all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The cavity shall be filled with low slump portland cement concrete or mortar, or with epoxy resin concrete or mortar. Portland cement concrete shall be used for larger spalls, those more than 0.009 cubic meter in size after removal operations; portland cement mortar shall be used for spalls between 0.00085 and 0.009 cubic meter; and epoxy resin mortar or Type III, Grade 3 epoxy resin for those spalls less than 0.00085 cubic meter in size after removal operations. Portland cement concretes and mortars shall be very low slump mixtures, proportioned, mixed, placed, tamped, and cured. If the materials and procedures are approved in writing, latex modified concrete mixtures may be used for repairing spalls less than 0.009 cubic meter in size. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions, mixing, placing, tamping and curing procedures as recommended by the manufacturer. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints. In lieu of sawing, spalls not adjacent to joints, and popouts, both less than 150 mm in maximum dimension, may be prepared by drilling a core 50 mm in diameter greater than the size of the defect, centered over the defect, and 50 mm deep or 13 mm into sound concrete, whichever is greater. The core hole shall be repaired as specified above for other spalls.

3.8.3 Areas Defective in Plan Grade or Smoothness

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with a surface grinding machine after the concrete is 14 days or more old. The depth of grinding shall not exceed 6 mm. All pavement areas requiring plan grade or surface smoothness corrections in excess of the specified limits, shall be removed and

replaced. All areas in which grinding has been performed will be subject to the thickness tolerances specified in paragraph Thickness. Any grinding performed on individual slabs with excessive deficiencies shall be performed at the Contractor's own decision without entitlement to additional compensation if eventual removal of the slab is required.

3.9 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

Existing concrete pavement shall be removed as indicated and as specified in Section 02050 DEMOLITION modified, and expanded as specified herein. Removal, repair and replacement shall be made as indicated and as specified in paragraph REPAIR, REMOVAL, AND REPLACEMENT OR SLABS.

3.10 PAVEMENT PROTECTION

The Contractor shall protect the pavement against all damage prior to final acceptance of the work. Traffic shall be excluded from the new pavement. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean. Special cleaning and care shall be used where Contractor's traffic uses or crosses active airfield pavement.

3.11 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL (CQC)

Paragraph ACCEPTABILITY OF WORK contains additional CQC requirements. The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and submit reports as specified. When, in the opinion of the Contracting Officer, the paving operation is out of control, concrete placement shall cease.

3.11.1 Batch Plant Control

A daily report shall be prepared indicating checks made for scale accuracy with test weights, checks of batching accuracy, and corrective action taken prior to and during placement for weighing or batching, type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water masses per cubic meter, amount of water as free moisture in each size of aggregate, and the batch aggregate and water masses per cubic meter for each class of concrete batched during each day's plant operation.

3.11.2 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two other tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of paving. Whenever air content reaches specified limits, an immediate confirmatory test shall be made. If the second test also shows air content at or exceeding specified limits, an adjustment shall immediately be made in the amount of air-entraining admixture batched to bring air content within specified limits. If the next adjusted batch of concrete is not within specified limits, concrete placement shall be halted until concrete air content is within specified limits.

b. Slump Testing. Slump tests shall be made when test specimens are fabricated. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Whenever slump approaches the maximum limit, an adjustment shall immediately be made in the batch masses of water and fine aggregate, without exceeding the maximum w/(c+p). When a slump result exceeds the specification limit, no further concrete shall be delivered to the paving site until adjustments have been made and slump is again within the limit.

c. Temperature. The temperature of the concrete shall be measured when strength specimens are fabricated.

d. Concrete Strength Testing. Four (4) cylinders from the same batch shall be fabricated, cured and tested for compressive strength, testing two cylinders at 7-day and two cylinders at 28-day age. Control charts for strength, showing the 7-day and 28-day CQC compressive strengths, and the 28-day required compressive strength, shall be maintained and submitted with weekly CQC Reports.

3.11.3 Inspection Before Placing

Underlying materials, joint locations and types, construction joint faces, forms, dowels, and embedded items shall be inspected by a Registered Engineer in sufficient time prior to each paving operation in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing, and the certification signed by the Registered Engineer, prior to each days' paving.

3.11.4 Paving Operations

The placing foreman shall supervise all placing and paving operations, shall determine that the correct quality of concrete is placed in each location as shown, shall insure that the concrete is consolidated full depth and that finishing is performed as specified. The placing foreman shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume of concrete placed, and method of paving and any problems encountered.

3.11.5 Curing Inspection

a. Moist Curing Inspections. Each day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded. When any inspection finds an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for the area shall be extended by 1 day.

b. Membrane Curing Inspection. At the end of each day's placement, the CQC Representative shall determine the quantity of compound used by measurement of the container; shall determine the area of concrete surface covered; shall then compute the rate of coverage in square meters per L and shall also note whether or not coverage is uniform. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

3.11.6 Cold-Weather Protection

At least once per day, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.11.7 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report, signed by a registered engineer, shall be prepared for the updating of control charts and test data, and all CQC inspections and actions covering the entire period from the start of the construction through the current week. Reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all CQC records. At the completion of concrete placement, a certification report shall be prepared containing mix designs, all updated control charts and concrete test data, quality control reports, smoothness reports, and other pertinent data on the concrete, with a certification by a registered engineer that the concrete placed meets all specification requirements.

-- End of Section --

SECTION 02760

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in this text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM D 789	(1994) Determination of Relative Viscosity, Melting Point, and Moisture Content of Polyamide (PA)

FEDERAL SPECIFICATIONS (FS)

FS SS-S-200	(Rev E; Am 2) Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-06 Instructions

Manufacturer's Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer's recommendations, printed copies of these recommendations, 30 days prior to use on the project. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

SD-07 Schedules

Construction Equipment List; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use on the project.

1.4 NOT USED

1.5 TEST REQUIREMENTS

The joint sealant and backup or separating material shall be tested for conformance with the referenced applicable material specification. Testing of the materials shall be performed in an approved independent laboratory and certified copies of the test reports shall be submitted and approved 30 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

1.6 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.

1.6.1 Joint Cleaning Equipment

1.6.1.1 NOT USED

1.6.1.2 Concrete Saw

A self-propelled power saw with water-cooled diamond or abrasive saw blades will be provided for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not provide a clean joint.

1.6.1.3 NOT USED

1.6.1.4 Waterblasting Equipment

Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary resupply equipment shall be of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjustable as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch at which the equipment is operating.

1.6.1.5 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.

1.6.2 Sealing Equipment

1.6.2.1 NOT USED

1.6.2.2 Two-Component, Cold-Applied, Machine Mix Sealing Equipment

The equipment used for proportioning, mixing, and installing FS SS-S-200 Type M joint sealants shall be designed to deliver two semifluid components

through hoses to a portable mixer at a preset ratio of 1 to 1 by volume using pumps with an accuracy of plus or minus 5 percent for the quantity of each component. The reservoir for each component shall be equipped with mechanical agitation devices that will maintain the components in a uniform condition without entrapping air. Provisions shall be incorporated to permit thermostatically controlled indirect heating of the components, when required. However, immediately prior to proportioning and mixing, the temperature of either component shall not exceed 32.2 degrees C. Screens shall be provided near the top of each reservoir to remove any foreign particles or partially polymerized material that could clog fluid lines or otherwise cause misproportioning or improper mixing of the two components. The equipment shall be capable of thoroughly mixing the two components through a range of application rates of 37.8 to 189 liters per hour and through a range of application pressures from 345 kPa to 10.3 MPa as required by material, climatic, or operating conditions. The mixer shall be designed for the easy removal of the supply lines for cleaning and proportioning of the components. The mixing head shall accommodate nozzles of different types and sizes as may be required by various operations. The dimensions of the nozzle shall be such that the nozzle tip will extend into the joint to allow sealing from the bottom of the joint to the top. The initially approved equipment shall be maintained in good working condition, serviced in accordance with the supplier's instructions, and shall not be altered in any way without obtaining prior approval.

1.7 NOT USED

1.8 DELIVERY AND STORAGE

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided by the Contractor at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

1.9 ENVIRONMENTAL CONDITIONS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 10 degrees C and rising at the time of application of the materials. Sealant shall not be applied if moisture is observed in the joint.

PART 2 PRODUCTS

2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

Area	Sealing Material
All areas	FS SS-S-200 Type M

2.2 PRIMERS

Primers, when their use is recommended by the manufacturer of the sealant, shall be as recommended by the manufacturer of the sealant.

2.3 BACKUP MATERIALS

The backup material shall be a compressible, nonshrinking, nonstaining, nonabsorbing material and shall be nonreactive with the joint sealant. The material shall have a melting point at least 3 degrees C greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C 509. The backup material shall be 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

The bond breaking tape or separating material shall be a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 3 degrees C greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 3 mm wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

Immediately before the installation of the sealant, the joints shall be thoroughly cleaned to remove all laitance, curing compound, filler, and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed.

3.1.1 NOT USED

3.1.2 Sawing

3.1.2.1 Facing of Joints

Facing of joints shall be accomplished using a concrete saw as specified in paragraph EQUIPMENT to saw through sawed and filler-type joints to loosen and remove material until the joint is clean and open to the full specified width and depth. The blade shall be stiffened with a sufficient number of suitable dummy (used) blades or washers. Immediately following the sawing operation, the joint opening shall be thoroughly cleaned using a water jet or compressed air to remove all saw cuttings and debris.

3.1.3 Waterblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 13 mm from the joint edges shall be waterblasted clean. A multiple-pass technique shall be used until the surfaces are free of dust, dirt, curing compound, residue, or any foreign debris that might prevent the bonding of the sealant to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

3.1.4 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, the lower portion of the joint opening shall be plugged or sealed off using a back-up material to prevent the entrance of the sealant below

the specified depth. Care shall be taken to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.1.5 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, a bond breaker separating tape will be inserted to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. The tape shall be securely bonded to the bottom of the joint opening so it will not float up into the new sealant.

3.1.6 Rate of Progress of Joint Preparation

The stages of joint preparation which include waterblasting, air pressure cleaning and placing of the back-up material shall be limited to only that lineal footage that can be sealed during the same day.

3.2 PREPARATION OF SEALANT

3.2.1 NOT USED

3.2.2 Type M Sealants

The FS SS-S-200 Type M sealant components and containers shall be inspected prior to use. Any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory shall be rejected. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools shall not be cause for rejection. Prior to transfer of the components from the shipping containers to the appropriate reservoir of the application equipment, the materials shall be thoroughly mixed to ensure homogeneity of the components and incorporation of all constituents at the time of transfer. When necessary for remixing prior to transfer to the application equipment reservoirs, the components shall be warmed to a temperature not to exceed 32 degrees C by placing the components in heated storage or by other approved methods but in no case shall the components be heated by direct flame, or in a single walled kettle, or a kettle without an oil bath.

3.3 INSTALLATION OF SEALANT

3.3.1 Time of Application

Joints shall be sealed immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

3.3.2 Sealing Joints

Immediately preceding, but not more than 15 m ahead of the joint sealing operations, a final cleaning with compressed air shall be performed. The joints shall be filled from the bottom up to 3 mm plus or minus 1.5 mm below the pavement surface. Excess or spilled sealant shall be removed from the pavement by approved methods and shall be discarded. The sealant shall be installed in such a manner as to prevent the formation of voids

and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, it shall be applied evenly to the joint faces in accordance with the manufacturer's instructions. Joints shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.4 INSPECTION

3.4.1 Joint Cleaning

Joints shall be inspected during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints shall be approved prior to installation of the separating or back-up material and joint sealant.

3.4.2 Joint Sealant Application Equipment

The application equipment shall be inspected to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set shall be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.4.3 Joint Sealant

The joint sealant shall be inspected for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

3.5 CLEAN-UP

Upon completion of the project, all unused materials shall be removed from the site and the pavement shall be left in a clean condition.

-- End of Section --

SECTION 02935

TURF

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01	(Amended thru: Aug 1988) Federal Seed Act Regulations (Part 201-202)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 977	(1991) Emulsified Asphalt
ASTM D 2028	(1976; R 1992) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2607	(1969) Peats, Mosses, Humus, and Related Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	(Basic; Notice 1) Fertilizer

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Literature; FIO.

Manufacturer's literature discussing physical characteristics, application and installation instructions for erosion control material, and for chemical treatment material.

SD-08 Statements

Delivery; FIO.

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

Maintenance Report; FIO.

Written record of maintenance work performed.

Turf Establishment Period; FIO.

Written calendar time period for the turf establishment period. When there is more than one turf establishment period, the boundaries of the turfed area covered for each period shall be described.

SD-13 Certificates

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Certified copies of the reports for the following materials shall be included:

Seed; FIO.

For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, date tested and state certification.

Sod; FIO.

For species, mixture percentage, percent purity, field location.

Fertilizer; FIO.

For chemical analysis, composition percent.

Agricultural Limestone; FIO.

For calcium carbonate equivalent and sieve analysis.

1.3 SOURCE INSPECTIONS

Sod material will be subject to inspection by the Contracting Officer at the growing site.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

1.4.1.1 Protection

Sod shall be protected from drying out and contamination during delivery.

1.4.1.2 Topsoil

A soil test shall be provided for topsoil delivered to the site.

1.4.1.3 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.4 Pesticide

Pesticide material shall be delivered to the site in the original, unopened

containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration number and the manufacturer's registered uses.

1.4.2 Inspection

Seed and sod shall be inspected upon arrival at the job site by the Contracting Officer for conformity to type and quality in accordance with paragraph MATERIALS. Other materials shall be inspected for meeting specified requirements and unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in areas designated by the Contracting Officer. Sod shall be lightly sprinkled with water, covered with moist burlap, straw, or other covering and protected from exposure to wind and direct sunlight until planted. Covering for sod shall allow air to circulate and prevent internal heat from building up. Seed, lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

1.4.4 Handling

1.4.4.1 Materials

Care shall be taken to avoid injury to sod. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.4.2 Time Limitation

a. Sod: Limitation of the time between harvesting and placing of sod shall be 36 hours.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Seed

2.1.1.1 Seed Classification

State-approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.1.2 Seed Mixtures

Seed mixtures shall comply with all state and federal seed laws.

2.1.1.3 Quality

Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

2.1.1.4 NOT USED

2.1.1.5 NOT USED

2.1.1.6 Seed Mixing

The field mixing of seed shall be performed on site in the presence of the Contracting Officer.

2.1.2 Sod

2.1.2.1 Sod Classification

State-certified sod shall be provided as classified by applicable state laws. Each individual sod section shall be of a size to permit rolling and lifting without breaking.

2.1.2.2 NOT USED

2.1.2.3 Quality

The sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 50 mm in any dimension, woody plant roots and other material detrimental to a healthy stand of turf. Sod that has become dry, moldy, or yellow from heating, or has irregularly shaped pieces of sod and torn or uneven ends shall be rejected.

2.1.2.4 Thickness

Sod shall be machine cut to a uniform thickness of 30 mm within a tolerance of 5 mm, excluding top growth and thatch. Measurement for thickness shall exclude top growth and thatch.

2.1.2.5 Anchors

Sod anchors shall be as recommended by the sod supplier.

2.1.3 NOT USED

2.1.4 Soil Amendments

Soil amendments shall consist of lime, fertilizer, organic soil amendments and soil conditioners meeting the following requirements.

2.1.4.1 Lime

Lime shall be agricultural limestone and shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground to such a fineness that at least 90 percent will pass a 10-mesh sieve and at least 50 percent will pass a 60-mesh sieve.

2.1.4.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909. Granular Fertilizer: As recommended by the soil test.

2.1.4.3 Organic Soil Amendments

a. Topsoil: The existing surface soil shall be stripped and stockpiled on the site. When required beyond that available from

stripping, the topsoil shall be delivered. Delivered topsoil shall conform to topsoil requirements specified, and shall be amended as recommended by soil test.

b. Peat: Peat moss derived from a bog, swampland or marsh shall conform to ASTM D 2607.

c. Sand: Clean, free of toxic materials; 95 percent by weight shall pass a No. 10 sieve and 10 percent by weight shall pass a No. 16 sieve.

d. Rotted Manure: Well rotted, horse or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials, free of stones, sticks, soil and containing no chemicals or ingredients harmful to plants.

e. Decomposed Wood Derivatives: Ground bark, sawdust, or other wood waste material free of stones, sticks, soil, and toxic substances harmful to plants, stabilized with nitrogen and having the following properties:

Particle Size: Minimum percent by weight passing:

Sieve Size	Percent
No. 4	95
No. 4	80

Nitrogen Content: Minimum percent based on dry weight:

Material	Percent
Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

f. Calcined Clay: Granular particles produced from montmorillonite clay calcined to minimum temperature of 650 degrees C to the following gradation: minimum 90 percent passing No. 8, 99 percent retained on No. 60 sieve and maximum 2 percent passing No. 100 sieve. Bulk density: maximum 640 kg per cubic m.

2.1.4.4 Soil Conditioner

Soil conditioner shall be for single use or in combination to meet requirements for topsoil. Gypsum shall be commercially packaged, free flowing, minimum 95 percent calcium sulfate by volume.

2.1.5 Mulch

Mulch shall be free from weeds, mold, and other deleterious materials.

2.1.5.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.1.5.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.1.5.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.1.5.4 Wood Chips

Wood chips shall be chips or shredded bark with maximum particle size of 5 mm.

2.1.5.5 Paper Fiber Mulch

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.1.6 Asphalt Adhesive

Asphalt adhesive shall conform to the following:

2.1.6.1 Emulsified Asphalt

Conforming to ASTM D 977, Grade SS-1.

2.1.6.2 Cutback Asphalt

Conforming to ASTM D 2028, designation RC-70.

2.1.7 Water

Water shall not contain elements toxic to plant life.

2.1.8 Pesticide

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide and miticide. For the purpose of this specification, soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.1.9 Erosion Control Material

Soil erosion control shall conform to the following:

2.1.9.1 Soil Erosion Control Blanket

Machine produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either knitted straw blanket-like mat construction, covered with biodegradable plastic mesh, or interwoven biodegradable thread, plastic netting or twisted kraft paper cord netting.

2.1.9.2 Soil Erosion Control Fabric

Knitted construction of polypropylene yarn with uniform mesh openings 20 t0 25 mm with strips of biodegradable paper. Filler paper strips shall last 6 to 8 months.

2.1.9.3 Soil Erosion Control Net

Heavy, twisted jute mesh weighing approximately 605 grams per meter and 1200 mm wide with mesh openings of approximately 25 mm.

2.1.9.4 Soil Erosion Control Chemicals

High-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.1.9.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life, without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids must resist mold growth.

2.1.9.6 Anchors

Erosion control anchor material shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 SEEDING, SODDING AND SPRIGGING TIMES AND CONDITIONS

3.1.1 Seeding Time

Seed shall be sown from Jan 1 to June 1 or from Sept 1 to Dec 1 for fall planting.

3.1.2 Sodding Time

Sod shall be placed from Jan 1 to June 1 or from Sept 1 to Dec 1 for fall planting.

3.1.3 NOT USED

3.1.4 Turfing Conditions

Turf operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the turf operations, proposed times shall be submitted to and approved by the Contracting Officer.

3.2 SITE PREPARATION

3.2.1 Grading

The Contracting Officer shall verify that finished grades are as indicated on drawings, and the placing of topsoil and the smooth grading has been completed in accordance with Section 02225.

3.2.2 Application of Soil Amendments

3.2.2.1 Soil Test

A soil test shall be performed for pH, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of turf specified.

3.2.2.2 Lime

Lime shall be applied at the rate recommended by the soil test. Lime shall be incorporated into the soil to a minimum depth of 100 mm or may be incorporated as part of the tillage operation.

3.2.2.3 Fertilizer

Fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated into the soil to a minimum depth of 100 mm and may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.4 Soil Conditioner

Soil Conditioner shall be spread uniformly over the soil to a minimum depth of 15 millimeters and thoroughly incorporated by tillage into the soil to a minimum depth of 100 mm.

3.2.3 Tillage

3.2.3.1 Minimum Depth

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of 100 mm. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum depth of 50 mm by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required.

3.2.4 Finished Grading

3.2.4.1 Preparation

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified. Finished grade shall be 25 mm below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.4.2 Lawn Area Debris

Lawn areas shall have debris and stones larger than 25 mm in any dimension removed from the surface.

3.2.4.3 Field Area Debris

Field areas shall have debris and stones larger than 75 mm in any dimension removed from the surface.

3.2.4.4 Protection

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

3.3 SEEDING

3.3.1 General

Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rain, traffic or other cause, shall be reworked to restore the ground condition previously specified. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.2 Equipment Calibration

The equipment to be used and the methods of turfing shall be subject to the inspection and approval of the Contracting Officer prior to commencement of turfing operations. Immediately prior to the commencement of turfing operations, the Contractor shall conduct turfing equipment calibration tests in the presence of the Contracting Officer.

3.3.3 Applying Seed

3.3.3.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 1 kilograms per hectare using broadcast seeders. Half of seed shall be broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth of 5 mm by disk harrow, steel mat drag, cultipacker, or other approved device.

3.3.3.2 Drill Seeding

Seed shall be uniformly drilled to an average depth of 15 mm and at the rate of 1 kilograms per hectare using equipment having drills not more than 160 mm apart. Row markers shall be used with the drill seeder.

3.3.3.3 Rolling

Immediately after seeding, except for slopes 3-horizontal-to-1 vertical and greater, the entire area shall be firmed with a roller not exceeding 130 kg for each meter of roller width. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.4 Hydroseeding

Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed, fertilizer and water have been thoroughly mixed, to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.5 Mulch

3.3.5.1 Straw or Hay Mulch

Straw or hay mulch shall be spread uniformly at the rate of 4.5 metric tons per hectare. Mulch shall be spread by hand, blower-type mulch spreader or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered. The mulch shall not be bunched. All seeded areas shall be mulched on the same day as the seeding.

3.3.5.2 Mechanically Anchoring

Immediately following spreading, the mulch shall be anchored to the soil by a V-type-wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

3.3.5.3 Asphalt Adhesive Tackifier

When asphalt adhesive is applied to the in-place mulch, spraying shall be at the rate of between 400 to 500 liters per hectare.

3.3.5.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at rate recommended by manufacturer. Apply with hydraulic equipment suitable for mixing and applying uniform mixture of tackifier.

3.3.5.5 Spreading Asphalt Adhesive Coated Mulch

Straw or hay mulch shall be spread simultaneously with asphalt adhesive at the rate of 2 tons per acre by using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetration to the ground surface.

3.3.5.6 Wood Cellulose Fiber

Wood cellulose fiber mulch for use with the hydraulic application of seed and fertilizer shall be applied as part of the hydroseeding operation.

3.3.6 Water

Watering shall be started within 7 days after completing the seeded area. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 25 mm. Run-off and puddling shall be prevented.

3.4 SODDING

3.4.1 General

Areas shall be sodded as indicated. Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a minimum depth of 25 mm.

3.4.2 Placing Sod

Rows of sod shall be placed parallel to and tightly against each other. Joints shall be staggered laterally. The sod strips shall not be stretched or overlapped. All joints shall be butted tight. Voids and air drying of roots shall be prevented. On long slopes, sod shall be laid at right angles to slopes. In ditches, sod shall be laid at right angles to the flow of water. When required, the sod shall be anchored by placing anchors a

minimum distance of 600 mm on center with a minimum of 2 anchors per sod section.

3.4.3 Finishing

Air pockets shall be eliminated and a true and even surface shall be provided by tamping or rolling the sod in place. Displacement of the sod shall be assured by knitting of sod to the soil. Frayed edges shall be trimmed and holes or missing corners shall be patched in the sod.

3.4.4 Watering Sod

Watering shall be started immediately after completing each day of sodding. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 25 mm. Run-off and puddling shall be prevented.

3.5 NOT USED

3.6 EROSION CONTROL

3.6.1 Erosion Control Material

Erosion control material, where indicated or required, shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.6.2 Temporary Turf Cover

3.6.2.1 General

When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed as directed by the Contracting Officer.

3.6.2.2 Application

When no other turfing materials have been applied, the quantity of one half of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. Seed shall be uniformly broadcast and applied at the rate of 1 kilograms per square meter. The area shall be watered as required.

3.7 APPLICATION OF PESTICIDE

When pesticide becomes necessary to remove a pest or disease, a state-certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of pesticides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges.

3.8 RESTORATION AND CLEAN UP

3.8.1 Restoration

Existing turf areas, pavements and facilities that have been damaged from the turfing operation shall be restored to original condition at Contractor's expense.

3.8.2 Clean Up

Excess and waste material shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

3.9 PROTECTION OF TURFED AREAS

Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed by the Contracting Officer.

3.10 TURF ESTABLISHMENT PERIOD

3.10.1 Commencement

The Turf Establishment Period for establishing a healthy stand of turf shall begin on the first day of work under this contract and shall end three (3) months after the last day of turfing operations required by this contract. Written calendar time period shall be furnished to the Contracting Officer for the Turf Establishment Period. When there is more than one turf establishment period, describe the boundaries of the turfed area covered for each period.

3.10.2 Satisfactory Stand of Turf

3.10.2.1 Seeded Area

a. Lawn Area: A satisfactory stand of turf from the seeding operation for a lawn area is defined as a minimum of 160 grass plants per square meter. Bare spots shall be no larger than 150 mm square. The total bare spots shall not exceed 2 percent of the total seeded area.

3.10.2.2 Sodded Area

A satisfactory stand of turf from the sodding operation is defined as living sod uniform in color and leaf texture. Bare spots shall be no larger than 50 mm square.

3.10.3 Maintenance During Establishment Period

3.10.3.1 General

Maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, watering, and post-fertilization.

3.10.3.2 NOT USED

3.10.3.3 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 25 mm. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.10.3.4 Post-Fertilization

Nitrogen carrier fertilizer shall be applied at the rate of 2.5 kilogra ms per hectare after the first month and again in 3 months. The application shall be timed prior to the advent of winter dormancy and shall avoid excessively high nitrogen levels.

3.10.3.5 Pesticide

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.10.3.6 Repair

The Contractor shall re-establish as specified herein, eroded, damaged or barren areas. Mulch shall also be repaired or replaced as required.

3.10.3.7 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

3.11 FINAL ACCEPTANCE

3.11.1 Preliminary Inspection

Prior to the completion of the Turf Establishment Period, a preliminary inspection shall be held by the Contracting Officer. Time for the inspection shall be established in writing. The acceptability of the turf in accordance with the Turf Establishment Period shall be determined. An unacceptable stand of turf shall be repaired as soon as turfing conditions permit.

3.11.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing.

-- End of Section --

SECTION 03100

STRUCTURAL CONCRETE FORMWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 347R (1994) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1983) Construction and Industrial Plywood

1.2 NOT USED

1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

2.1.1 Forms For Class B Finish

Forms for Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6 mm nor more than 25 mm deep and not more than 25 mm in diameter. Removable tie rods shall be not more than 38 mm in diameter.

2.1.7 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet

with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS

Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. In no case will supporting forms or shores be removed before the concrete strength has reached 70 percent of design strengths as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 3 m of length ----- 6 mm
a. In the lines and surfaces of piers, walls and in arises	Maximum for entire length ----- 25 mm
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 6 m of length ----- 6 mm Maximum for entire length ---- 13 mm
2. Variation from the level or from the grades indicated on the drawings:	In any 3 m of length ----- 6 mm In any bay or in any 6 m of length ---------- 10 mm
a. In ceilings, and in arises, measured before removal of supporting shores	Maximum for entire length ---- 20 mm
b. In exposed lintels, sills, horizontal grooves, and other conspicuous lines	In any bay or in any 6 m of length ---------- 6 mm Maximum for entire length ---- 13 mm
3. Variation of the linear building lines from established position in plan	In any 6 m ---------- 13 mm Maximum ---------- 25 mm
4. Variation of distance	6 mm per 3 m of distance, but

TABLE 1

TOLERANCES FOR FORMED SURFACES

	between walls, partitions	not more than 13 mm in any one bay, and not more than 25 mm total variation
5.	Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ---------- 6 mm Plus ---------- 13 mm
6.	Variation in the thickness of slabs and walls	Minus ---------- 6 mm Plus ---------- 13 mm
7.	Footings:	
a.	Variation of dimensions in plan when formed or plus 75 mm when placed against unformed excavation	Minus ---------- 13 mm Plus ---------- 50 mm
b.	Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than ---------- 50 mm
c.	Reduction in thickness	Minus ---------- 5 percent of specified thickness

-- End of Section --

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M	(1995) Building Code Requirements for Structural Concrete and Commentary (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1994) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(1995b) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(1995) Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A 775/A 775M	(1996) Epoxy-Coated Reinforcement Steel Bars
ASTM A 884/A 884M	(1996a) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1	(1996) Manual of Standard Practice

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Drawings

Concrete Reinforcement System

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 NOT USED

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall be smooth bars conforming to ASTM A 675/A 675M, Grade 550. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100

by 100 mm when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 13 mm of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318M . Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M . If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318M and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the

distance between the outermost crosswires plus 50 mm. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 1.2 m. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

-- End of Section --

SECTION 03250

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 471	(1995) Rubber Property - Effect of Liquids
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1854	(1974; R 1990) Specification for Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 1855	(1989) Test Method for Jet-Fuel Resistant Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 5249	(1992) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

CORPS OF ENGINEERS (COE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Data

Preformed Expansion Joint Filler; Sealant; Waterstops.

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops.

Instructions

Sealant; Waterstops

Manufacturer's recommended instructions for installing; and waterstops; and for splicing non-metallic waterstops.

SD-13 Certificates

Sealant; Waterstops

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 3 mm thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 13 mm thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 NOT USED

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 NOT USED

2.3.5 Hot-Applied Jet-Fuel Resistant Type

ASTM D 1854 tested in accordance with ASTM D 1855.

2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

2.4.1 NOT USED

2.4.2 NOT USED

2.4.3 Non-Metallic

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized. Materials for construction joints, expansion joints and waterstops shall be installed and braced in the forms prior to placmenet of concrete.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 3 mm wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 25 mm.

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. Means shall be provided to insure true alignment of the strips is maintained during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 3 mm radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top thereof to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 NOT USED

3.2.2 NOT USED

3.2.3 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

3.2.3.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.3.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.3.3 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 2 mm. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 2 mm or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 13 mm in 3 m. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

-- End of Section --

SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214.3R	(1988) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results
ACI 305R	(1991) Hot Weather Concreting
ACI 318/318R	(1995) Building Code Requirements for Reinforced Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991) Burlap Cloth Made From Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1994) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 94	(1996) Ready-Mixed Concrete
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 171	(1995) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 192	(1990a) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 309	(1995) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 618	(1996a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 940	(1989) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 989	(1994a) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1064	(1986; R 1993) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1995a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1991a) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural

	Construction (Nonextruding and Resilient Bituminous Types)
ASTM E 96	(1995) Water Vapor Transmission of Materials

CORPS OF ENGINEERS (COE)

COE CRD-C 94	(1995) Surface Retarders
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1995) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA TMMB-01	(1992) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards of the Truck Mixer Manufacturers Bureau
NRMCA CPMB 100	(1990) Concrete Plant Standards
NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities

1.2 NOT USED

1.3 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Statements

Mixture Proportions

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

Reports

Testing and Inspection for Contractor Quality Control; GA.

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

Certificates

Qualifications

Written documentation for Contractor Quality Control personnel.

1.5 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
Concrete Laboratory Testing Technician, Grade I or II
Concrete Construction Inspector, Level II

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.6 NOT USED

1.7 SPECIAL REQUIREMENTS

A pre-installation meeting with the Contracting Officer will be required at least 10 days prior to start of construction on slabs and arms vault. The Contractor shall be responsible for calling the meeting; the Project Superintendent and active installation personnel shall be present.

1.8 GENERAL REQUIREMENTS

1.8.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.8.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.8.1.2 NOT USED

1.8.1.3 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 3 m straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Trowel Finish 5 mm

1.8.2 Strength Requirements and w/c Ratio

1.8.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
30 MPa at 28 days	All concrete

Concrete slabs on-grade shall have a 28-day flexural strength of 4.5 MPa. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39. Flexural strength shall be determined in accordance with ASTM C 78.

a. Evaluation of Concrete Compressive Strength. Compressive strength

specimens (152 by 305 mm cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31 and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 350 kPa. A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab

is considered potentially deficient.

1.8.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.45	All concrete

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where GGBF slag is used, the weight of the GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.8.3 Air Entrainment

All normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 19 mm or smaller it shall be between 4.5 and 7.5 percent. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.8.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143.

Structural Element	Slump Minimum	Slump Maximum
Walls	50 mm	100 mm
Foundation walls, footings, slabs	25 mm	75 mm
Any structural concrete approved for placement by pumping:		
At pump	50 mm	150 mm
At discharge of line	25 mm	100 mm

When use of a plasticizing admixture conforming to ASTM C 1017 or when a Type F or G high range water reducing admixture conforming to ASTM C 494 is permitted to increase the slump of concrete, concrete shall have a slump of 50 to 100 mm before the admixture is added and a maximum slump of 200 mm at the point of delivery after the admixture is added.

1.8.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 32 degrees C. When the ambient temperature during placing is 5 degrees C or less, or

is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 12 and 25 degrees C.

1.8.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.8.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.9 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.9.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192 and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in the paragraph Maximum Allowable w/c Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where GGBF slag is used, the weight of the GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or

placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.9.2 Proportioning Studies for Flexural Strength Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192 and tested in accordance with ASTM C 78. Procedures given in ACI 211.1 shall be modified as necessary to accommodate flexural strength.

1.9.3 NOT USED

1.9.4 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, the mixture shall be adjusted, as approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.9.4.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 7 MPa of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$f'cr = f'c + 1.34S$ where units are in MPa

$f'cr = f'c + 2.33S - 3.45$ where units are in MPa

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.9.4.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

$$f'cr = f'c + 8.3 \text{ MPa}$$

1.9.5 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.10 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.11 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.11.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.11.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.11.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.11.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement or portland cement in combination with pozzolan or ground granulated blast furnace slag and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I with a maximum 15 percent amount of tricalcium aluminate, or Type II.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 Pozzolan (Fly Ash)

ASTM C 618, Class C with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. If pozzolan is used, it shall never be less than 15 percent nor more than 25 percent by weight of the total cementitious material.

2.1.5 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size designation 67.

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.3.5 Surface Retarder

COE CRD-C 94.

2.3.6 NOT USED

2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade A and shall be a commercial formulation suitable for the proposed application.

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application.

2.11 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

2.12 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV.

2.13 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 0.15 mm or other equivalent material having a vapor permeance rating not exceeding 30 nanograms per Pascal per second per square meter (0.5 perms) as determined in accordance with ASTM E 96.

2.14 JOINT MATERIALS

2.14.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751. Materials for waterstops shall be in accordance with Section 03250 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section 07920 JOINT SEALING.

2.14.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 NOT USED

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02221EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. The concrete shall be placed without becoming

contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 NOT USED

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 300 mm. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 300 mm. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 50 mm wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering sand.

3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 300 mm of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB-01. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete.

3.2.1.1 General

The batching plant shall be located off site close to the project. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.1.4 Batching Tolerances

(A) Tolerances with Weighing Equipment

PERCENT OF REQUIRED

MATERIAL	WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94 applicable to central-mixed concrete.

3.3 NOT USED

3.4 NOT USED

3.5 NOT USED

3.6 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in agitators, or by approved pumping equipment or conveyors.

3.7 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.7.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 0.2 square meters. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 1.5 cubic meters shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.7.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.7.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.7.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.7.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 900 mm. The belt speed shall be a minimum of 90 meters per minute and a maximum of 225 meters per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend

through the reinforcing bars.

3.7.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 100 mm. Aluminum pipe shall not be used.

3.8 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.8.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 300 mm thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity.

3.8.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.6 mm, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform

spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.8.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 5 degrees C. The temperature of the concrete when placed shall be not less than 10 degrees C nor more than 25 degrees C. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.8.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 30 degrees C, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 49 degrees C. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	33 C
40-60	30 C
Less than 40	27 C

3.8.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable

wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.9 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. Joints in walls shall be at the underside of slabs and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 50 mm clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 1.5 kg per square meter asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07920 JOINT SEALING.

3.9.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 30 meters. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete walls or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 25 mm square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25 mm above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float,

and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.9.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations, use of snap-out plastic joint forming inserts or sawing a continuous slot with a concrete saw]. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 3 and 5 mm wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.9.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03250 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07920 JOINT SEALING.

3.9.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03250 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.9.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1 mm in 100 mm. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.10 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface,

not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.10.1 Class B Finish

Class B finish is required in the following areas, interior surfaces of arms vault and exposed surfaces of exterior walls. Fins, ravelings, and loose material shall be removed, all surface defects over 12 mm in diameter or more than 12 mm deep, shall be repaired and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained.

3.10.2 Class C Finish

Class C finish is required in the following areas, concealed surfaces of arms vault. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm deep or more than 50 mm in diameter shall be repaired. Defects more than 50 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep.

3.11 REPAIRS

3.11.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 100 mm shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm (No. 16) sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be

moist cured for at least 48 hours.

3.11.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm deep or, for Class B finishes, more than 12 mm in diameter and, for Class C finishes, more than 50 mm in diameter. Also included are any defects of any kind whose depth is over 100 mm or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.11.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 50 mm on all sides. All such defective areas greater than 7800 square mm shall be outlined by saw cuts at least 25 mm deep. Defective areas less than 7800 square mm shall be outlined by a 25 mm deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.11.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 150 mm deep and also have an average diameter at the surface more than 450 mm or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and

placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.12 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.12.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 10 degrees C. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.12.2 NOT USED

3.12.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The following areas, top of arms vault roof slab shall be

given only a float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 6 mm and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.12.4 Troweled Finish

The following areas all interior slabs on grade shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 3 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.12.5 NOT USED

3.12.6 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

3.13 FLOOR HARDENER

Areas as indicated on the drawings. The following areas: mechanical rooms, tool rooms, rotor hub room, sheet metal room, engine room and the hanger bay slabs shall be treated with floor hardener. Floor hardener shall be applied after the concrete has been cured and then air dried for 14 days. Three coats shall be applied, each the day after the preceding coat was applied. For the first application, 0.5 kg of the silocofluoride shall be dissolved in 4 liters of water. For subsequent applications, the solution shall be 1.0 kg of silicofluoride to each 4 liters of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted salts. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

3.14 EXTERIOR SLAB AND RELATED ITEMS

3.14.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 3.75 m in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 1 m longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 3.75 m straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 1.0 to 1.5 m wide and 0.7 m longer than the pavement width shall be carefully pulled across the surface. Edges and joints shall be rounded with an edger having a radius of 3 mm. Curing shall be as specified.

3.14.2 Sidewalks

Concrete shall be 100 mm minimum thickness. Contraction joints shall be provided at 1.75 m spaces unless otherwise indicated. Contraction joints shall be cut 25 mm deep with a jointing tool after the surface has been finished. Transverse expansion joints 12 mm thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1 mm per 50 mm shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1 mm per 250 mm.

3.14.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 75 mm deep with a jointing tool after the surface has been finished. Expansion joints (12 mm wide)

shall be provided at 35 m maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.14.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.15 CURING AND PROTECTION

3.15.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 10 degrees C for the first 3 days and at a temperature above 0 degrees C for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.15.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.15.3 Membrane Forming Curing Compounds

Membrane forming curing compounds shall be used only on surfaces in the following areas, exterior slabs pavements and walks and arm vault roof slab. Concrete in the these areas may be cured with a nonpigmented curing compound containing a fugitive dye in lieu of moist curing. Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 500 kPa, at a uniform coverage of not more than 10 cubic meters per L for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.15.4 NOT USED

3.15.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete.

3.15.6 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 0 degrees C the temperature of the concrete shall be maintained above 5 degrees C for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 13 degrees C as determined by suitable temperature measuring devices furnished by the Government, as required, and installed adjacent to the concrete surface and 50 mm inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.16 SETTING BASE PLATES

After being properly positioned, column base plates, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 20 mm. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed.

3.16.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.16.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.16.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 18 to 30 degrees C until after setting.

3.16.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.17 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077.

3.17.1 Grading and Corrective Action

3.17.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.17.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.17.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.17.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the

plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.17.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter for each class of concrete batched during each day's plant operation.

3.17.5 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment

shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143 for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 12.5 mm below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 50 mm. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall

immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 380 cubic meters or portion thereof of that concrete mixture placed each day. When concrete is conveyed by belt conveyor or by pumps, samples shall be taken from the discharge end of the conveying equipment. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39 for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.17.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.17.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.17.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.17.9 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square meters per Liter, and shall note whether or not coverage is uniform.

d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.17.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.17.11 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 60,000 cubic meters of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94.

b. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.17.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

SECTION 04200

MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI SP-66	(1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1994) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615M	(1995) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 67	(1994) Sampling and Testing Brick and Structural Clay Tile
ASTM C 90	(1995) Loadbearing Concrete Masonry Units
ASTM C 91	(1995) Masonry Cement
ASTM C 216	(1995) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1995) Mortar for Unit Masonry
ASTM C 476	(1991) Grout for Masonry
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 578	(1992) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 641	(1982; R 1991) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(1994) Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM C 780	(1994) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1019	(1989a; R 1993) Sampling and Testing Grout
ASTM C 1072	(1994) Measurement of Masonry Flexural Bond Strength
ASTM C 1289	(1995) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2000	(1990; R 1994) Rubber Products in Automotive Applications
ASTM D 2240	(1991) Rubber Property - Durometer Hardness
ASTM D 2287	(1992) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

1.2 SUBMITTALS

The following shall be submitted in accordance with SECTION 01300 SUBMITTAL PROCEDURES:

Data

Clay or Shale Brick; Concrete Masonry Units; Insulation.

Manufacturer's descriptive data.

Drawings

Masonry Work

Drawings showing the location and layout of concrete masonry units. Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66.

Statements

Cold Weather Installation

Cold weather construction procedures.

SD-09 Reports

Efflorescence Test; Field Testing of Mortar; Field Testing of Grout; Prism tests; Masonry Cement; Fire-rated CMU.

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Certificates

Clay or Shale Brick; Concrete Masonry Units (CMU); Control Joint Keys; Anchors, Ties, and Bar Positioners; Expansion-Joint Materials; Joint Reinforcement; Reinforcing Steel Bars and Rods; Masonry Cement; Mortar Coloring; Insulation; Precast Concrete Items; Mortar Admixtures; Grout Admixtures.

Certificates of compliance stating that the materials meet the specified requirements.

Insulation.

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Samples

Concrete Masonry Units (CMU); Clay or Shale Brick.

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture.

Anchors, Ties, and Bar Positioners

Two of each type used.

Expansion-Joint Material.

One piece of each type used.

Joint Reinforcement.

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation.

One piece of board type insulation, not less than 400 mm by 600 mm in size, containing the label indicating the rated permeance and R-values.

Portable Panel.

One panel of clay or shale brick, 600 mm by 600 mm, containing approximately 24 brick facings to establish range of color and texture.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 2.5 m by 1.8 m.

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 600 mm by 600 mm opening placed at least 600 mm above the panel base and 600 mm away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90when delivered to the jobsite. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Grade SW shall be used for brick in contact with earth or grade and for the first six exterior courses above grade. Grade SW or MW shall be used in other brickwork. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

Solid clay or shale shall conform to ASTM C 216, Type FBS. Brick size shall be modular and the nominal size of the brick used shall be 92 mm, 57 mm wide, and 194 mm long. Minimum compressive strength of the brick shall be 15.2 MPa.

2.2.2 Hollow Clay or Shale Brick

Hollow clay or shale brick shall conform to ASTM C 652, Type HBX. Brick size shall be modular and the nominal size of the brick used shall be 92 mm thick, 57 mm wide, and 194 mm long. Where vertical reinforcement is shown in hollow brick, the minimum cell dimension shall be 64 mm and the units shall be designed to provide precise vertical alignment of the cells. Minimum compressive strength of the brick shall be 15.2 MPa.

2.3 NOT USED

2.4 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I, Normal weight. Cement shall have a low alkali content and be of one brand.

2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 25 mm. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 MORTAR

Mortar shall be Type S in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Evaluation of performance shall be based on ASTM C 780 and ASTM C 1072. Pointing mortar in showers shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source. Mortar color shall be reddish tan to match Medusa Stoneset - Natural Sand.

2.10.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.11 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low

alkali content. Grout slump shall be between 200 and 250 mm. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.11.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.11.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.12 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 16 mm mortar cover from either face.

2.12.1 NOT USED

2.12.2 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 5 mm diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 100 mm wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 5 mm diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 13 mm eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 2 mm. The pintle and eye elements shall be formed so that both can be in the same plane.

2.12.3 NOT USED

2.12.4 Adjustable Anchors

Adjustable anchors shall be 5 mm diameter steel wire, triangular-shaped. Anchors attached to steel shall be 8 mm diameter steel bars placed to provide 2 mm play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.12.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.13 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 16 mm cover from either face. The distance between crosswires shall not exceed 400 mm. Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.14 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615M, Grade 400.

2.15 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 16 mm thick and 10 mm thick flanges, with a tolerance of plus or minus 2 mm. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 34 degrees C after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.16 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07900 JOINT SEALING.

2.17 INSULATION

2.17.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyurethane or polyisocyanurate shall conform to ASTM C 1289, Type I, Class 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.17.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 50 mm, and a minimum air space of 20 mm.

2.17.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 2 (11) for the overall thickness. The aged R-value shall be determined at 24 degrees C in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.17.1.3 Recovered Material

Insulation shall contain the highest practicable percentage of recovered material derived from solid waste (but material reused in the manufacturing process cannot be counted toward the percentage of recovered material). Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. The polyurethane or polyisocyanurate foam shall have a minimum recovered material content of 9 percent by weight of the core material.

2.17.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.18 FLASHING

Flashing shall be as specified in Section 07620 SHEET METAL FLASHING AND TRIM.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 37 degrees C in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 4 degrees C, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 4 to 0 degrees C. Sand or mixing water shall be heated to produce mortar temperatures between 4 degrees C and 49 degrees C.

b. Air Temperature 0 to minus 4 degrees C. Sand and mixing water shall be heated to produce mortar temperatures between 4 degrees C and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature minus 4 to minus 7 degrees C. Sand and mixing water shall be heated to provide mortar temperatures between 4 degrees C and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 24 km/hour.

d. Air Temperature minus 7 degrees C and below. Sand and mixing water shall be heated to provide mortar temperatures between 4 degrees C and 49 degrees C. Enclosure and auxiliary heat shall be provided to maintain air temperature above 0 degrees C. Temperature of units when laid shall not be less than minus 7 degrees C.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 4 degrees C to 0 degrees C. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 0 degrees C to minus 4 degrees C. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature minus 4 degrees C to minus 7 degrees C. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature minus 7 degrees C and Below. Masonry temperature shall be maintained above 0 degrees C for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 13 mm. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be free from chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical

face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 13 mm into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 400 mm ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 200 mm.

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 3 mm. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 0.155 gm per minute per square cm (1 gm per minute per square inch) of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variation from level for bed joints and top surfaces of bearing walls	
In 3 m	6 mm
In 12 m or more	13 mm
Variations from horizontal lines	
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	6 mm
Plus	13 mm

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 300 mm wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm joints.

3.2.8.2 NOT USED

3.2.8.3 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 100 mm above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 100 mm nominal thick units shall be tied to intersecting partitions of 100 mm units, 125 mm into partitions of 150 mm units, and 175 into partitions of 200 mm or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 100 mm thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 100 mm of coarse aggregate or 250 mm of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Weep holes with honey comb design, 63 mm high weep hole ventilators

conforming to ASTM D 2240 shall be provided not more than 600 mm on centers in mortar joints of the exterior wythe above wall flashing and near the top of the wall at the same spacing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be formed by placing short lengths of well-greased No. 10, 8 mm nominal diameter, braided cotton sash cord in the mortar and withdrawing the cords after the wall has been completed. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 400 mm on center vertically and 600 mm on center horizontally. Unit ties shall be spaced not over 600 mm on centers horizontally, in courses not over 400 mm apart vertically, staggered in alternate courses. Ties shall be laid not closer than 16 mm to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.10 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 50 mm of tops of walls.

3.10.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the

vertical reinforcement and shall not be placed in horizontal bed joints.

3.10.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.11 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 400 mm on center or as indicated. Reinforcement shall be lapped not less than 150 mm. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm cover to either face of the unit.

3.12 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. All hardened mortar projecting 1/4" or more into void spaces shall be removed prior to grouting. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.12.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m apart, or as required, to limit the horizontal flow of grout for each pour.

3.12.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.12.3 Grout Holes and Cleanouts

3.12.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 400 mm on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.12.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores

containing vertical reinforcement when the height of the grout pour exceeds 1.5 m. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 800 mm where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 75 by 100 mm openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.12.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.12.4 Grouting Equipment

3.12.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.12.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.12.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 1.5 m in height. High-lift grout methods shall be used on pours exceeding 1.5 m in height.

3.12.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 13 mm into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.12.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 6 mm into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 1.2 m in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 300 to 450 mm into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
0.3	Fine	Low Lift	20	40 x 50
1.5	Fine	Low Lift	50	50 x 75
2.4	Fine	High Lift	50	50 x 75
3.6	Fine	High Lift	65	65 x 75

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
7.3	Fine	High Lift	75	75 x 75
0.3	Coarse	Low Lift	40	40 x 75
1.5	Coarse	Low Lift	50	65 x 75
2.4	Coarse	High Lift	50	75 x 75
3.6	Coarse	High Lift	65	75 x 75
7.3	Coarse	High Lift	75	75 x 100

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:
a) The required minimum dimensions of total clear areas given in the table above;
b) The width of any mortar projections within the space;
c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 20 mm or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.13 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm shall be maintained between reinforcement and interior faces of units.

3.14 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 19 by 19 mm groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior

masonry walls, the exterior control joints shall be raked to a depth of 20 mm; backer rod and sealant shall be installed in accordance with Section 07900 JOINT SEALERS. Exposed interior control joints shall be raked to a depth of 6 mm. Concealed control joints shall be flush cut.

3.15 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.16 NOT USED

3.17 LINTELS

3.17.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 16 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 15 mm above the bottom inside surface of the lintel unit.

3.17.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 200 mm unless otherwise indicated on the drawings.

3.18 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.19 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.19.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm on centers vertically and 600 mm on center horizontally.

3.19.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 400 mm on centers vertically, and if applicable, not over 600 mm on centers horizontally.

3.20 PARGING

The outside face of below-grade exterior concrete-masonry unit walls enclosing usable rooms and spaces, except crawl spaces, shall be parged with type S mortar. Parging shall not be less than 13 mm thick troweled to a smooth dense surface so as to provide a continuous unbroken shield from top of footings to a line 150 mm below adjacent finish grade, unless otherwise indicated. Parging shall be coved at junction of wall and

footing. Parging shall be damp-cured for 48 hours or more before backfilling. Parging shall be protected from freezing temperatures until hardened.

3.21 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.22 NOT USED

3.23 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.23.1 Concrete Masonry Unit Surfaces

Exposed concrete masonry unit surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.23.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 30 milliliters trisodium phosphate and 30 milliliters laundry detergent to 1 liter of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.24 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300CAST-IN-PLACE STRUCTURAL CONCRETE.

3.25 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof system. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.26 TEST REPORTS

3.26.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.26.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa at 28 days.

-- End of Section --

SECTION 05055

WELDING, STRUCTURAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT-01	(1996) Recommended Practice SNT-TC-1A

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1994) Standard Welding Terms and Definitions
AWS D1.1	(1994) Structural Welding Code - Steel
AWS Z49.1	(1994) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC-04 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL

PROCEDURES:

Statements

Welding Procedure Qualifications

Welder, Welding Operator, and Tacker Qualification

Inspector Qualification

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

Records

Quality Control

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS

D1.1 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspection and nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT-01 for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT-01, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC-04 When AWS D1.1 and the AISC-04 specification conflict, the requirements of AWS D1.1 shall govern.

3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 1 meter intervals. Identification with die stamps or electric etchers shall not be allowed.

3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant, or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual, ultrasonic, and dye penetrant inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1.

3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings. Nondestructive testing shall be by visual inspection and ultrasonic, or dye penetrant methods. The minimum extent of nondestructive testing shall be random 20 percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 DESTRUCTIVE TESTS

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to insure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 05061

ULTRASONIC INSPECTION OF WELDMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT-01	(1996) Recommended Practice SNT-TC-1A
ASNT-04	(1994) Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 165	(1995) Liquid Penetrant Examination
ASTM E 709	(1995) Magnetic Particle Examination

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel

1.2 DEFINITIONS

1.2.1 A Scan

Method of data presentation on a cathode ray tube using rectangular coordinates in which a horizontal base line indicates elapsed time when reading from left to right. A vertical deflection in the base line indicates reflect signal amplitude.

1.2.2 Acoustically Similar Material

Material the same as that to be inspected; or another material proven to have acoustical velocity within plus or minus 3 percent and an attenuation within plus or minus 0.009843 dB/mm of the inspected material for the inspection frequency and wave mode, using the same mode as that to be used for inspection.

1.2.3 Amplitude

When referring to an indication in A scan presentation, amplitude is the vertical height of the indication measured from peak-to-peak for radio frequency indications and trace-to-peak for video indications.

1.2.4 Attenuation

Dissipation or loss of energy as ultrasonic vibrations travel through the material. Attenuation is caused almost entirely by scattering of the ultrasonic vibrations generated by the search unit.

1.2.5 Attenuation-Correction Controls

Circuitry to provide a continuous increase in amplification with respect to time. This circuitry compensates for the reduction in sensitivity with depth as a result of sound beam divergence and its attenuation in material.

1.2.6 Back Reflection or End Reflection

Reflection from the opposite side, end, or boundary of the material into which the ultrasonic energy was introduced.

1.2.7 Calibrated Gain Control (Attenuator)

Circuitry with which gain can be reduced finite amounts by switching electrical signal attenuation into the circuit.

1.2.8 Calibration

Process of comparing an instrument or device with a standard to determine accuracy or produce a scale.

1.2.9 Cathode Ray Tube (CRT)

An electron tube in which a controlled beam of electrons from the cathode is used to produce an image on a fluorescent screen at the end of the tube.

1.2.10 Couplant

Any material, usually a liquid or semiliquid, used between the search unit and the inspection surface to exclude air and to convey the ultrasonic vibrations between the search unit and the material being inspected.

1.2.11 Damping Control

Control that varies the duration of transducer ringing.

1.2.12 Decibel (dB)

Units for the logarithmic expression of the ratio of power levels. Power levels can be functions of voltage, current, or impedance, for example. Decibel units having no values of their own are only significant when a reference is stated, as 10 dB above one reference level or 6 dB below another reference level.

1.2.13 Delay Control

Means of delaying the pattern obtained on the CRT.

1.2.14 Discontinuity

Anything within a material that will cause a detectable interruption in an ultrasonic beam.

1.2.15 Distance-Amplitude Correction Curve

Curve showing the relationship between signal amplitude and equal-sized reflecting surfaces at various distances from the transducer. Reference standards are used to obtain such curves.

1.2.16 Dynamic Range

Ratio of maximum to minimum size of reflective areas that can be adequately distinguished on the CRT at a constant gain setting.

1.2.17 Effective Depth of Penetration

Maximum depth at which the sensitivity is satisfactory for the quality of test desired.

1.2.18 Examination

Within the context of this specification, is equivalent to the word "inspection."

1.2.19 Gain Control

Circuitry designed into the ultrasonic system to vary reflection amplitude. This control is usually calibrated in decibels. It is also called the sensitivity control.

1.2.20 Gross

Background displacement of the trace on the CRT from the established baseline due to the gain setting, the characteristics of the test equipment, or the material under examination.

1.2.21 Hertz

One complete set of recurrent values of a periodic quantity comprises a cycle. In other words, any one set of periodic variations starting at one condition and returning once to the same condition is a cycle.

1.2.22 Immersion Techniques

Test methods in which the part to be tested and the search units are immersed in water or other suitable liquid couplant. A mechanical device is used to firmly hold and direct the wave angle of the search unit. The search unit does not contact the item being inspected.

1.2.23 Indication

Visual presentation on the cathode ray screen resulting from a sound beam reflection from a boundary surface or discontinuity.

1.2.24 Initial Pulse Indication

Usually called the "initial pulse." A signal on the CRT screen marking the instant at which a voltage impulse is applied to the transmitting crystal. Its rising edge is frequently invisible due to the time lag in the probe shoe and the consequent necessity to ensure coincidence between the time base zero and the instant at which the transmitter pulse actually enters the material under test.

1.2.25 Linearity

Property of an instrument revealed by a linear change in reflected signal or displacement. The vertical linearity is determined by plotting the change in ratios of signal amplitude from two adjacent reflections from an area of known size. The horizontal linearity is determined by plotting the distance the signal is displaced along the sweep against the change in material thickness or by noting the spacing of multiple back reflections.

1.2.26 Longitudinal or Compressional Waves

Simple compression-rare-fraction waves in which particle motion within a material is linear and in the direction of wave propagation. Also called straight beams, or compressional or normal waves.

1.2.27 Longitudinal Wave Inspection

Ultrasonic technique, normally using straight beam methods, in which longitudinal waves are the dominant form.

1.2.28 Mid-Screen Reflection

Reflection whose amplitude is equal to one-half the usable screen height on the CRT.

1.2.29 Megahertz (MHz)

One million hertz per second frequency.

1.2.30 NDT Level I

An NDT Level I individual should be qualified to properly perform specific calibrations, specific NDT, and specific evaluations for acceptance or rejection determinations according to written instructions and to record results.

1.2.31 NDT Level II

An NDT Level II individual should be qualified to set up and calibrate equipment and to interpret and evaluate results with respect to applicable codes, standards, and specifications.

1.2.32 NDT Level III

An NDT Level III individual should be capable of establishing techniques and procedures; interpreting codes, standards, specifications, and procedures; and designating the particular NDT methods, techniques, and procedures to be used.

1.2.33 Node

Distance a shear wave travels in a straight line from the inspection surface before being reflected by the opposite surface.

1.2.34 Pulse Repetition Rate

Number of spaced pulses of sound per second sent into the material being inspected.

1.2.35 Range Control

Means of expanding the pattern obtained on the CRT so that any portion of the total distance being tested can be presented.

1.2.36 Reference Reflector

Standard reflector 1.52 mm diameter reference hole in the IIW reference block. Other approved blocks may have a different diameter reflector.

1.2.37 Reflector

Boundary, consisting of an opposite side, crack, or separation, or a distinct change in material such as slag or porosity that reflects the ultrasonic energy the same as a mirror reflects light.

1.2.38 Refracted Waves

Waves that have undergone change of velocity and direction by passing from one material to another material with different acoustical properties. Refraction will occur wherever the angle of the incident wave to the interface is other than perpendicular.

1.2.39 Rejectable Discontinuity (Defect)

Reflector large enough to produce a signal (decibel rating) that exceeds the reject/repair line.

1.2.40 Resolution

Ability to clearly distinguish signals obtained from two reflective surfaces with a minimum separation distance. Near-surface resolution is the ability to clearly distinguish a signal from a reflector at a minimum distance under the contact or near surface without interference from the initial pulse signal. Far-surface resolution is the ability to clearly distinguish signals from reflectors displaced at minimum distances from the far or back surface when the sound beam is normal to that back surface.

1.2.41 Ringing

Excitation in a transducer due to the application of a short pulse of high voltage.

1.2.42 Scanning

Procedure of moving the search unit or units along a test surface to obtain complete inspection of the entire volume of a material being inspected. Preliminary scanning refers to a somewhat common practice of rapidly traversing a weld ultrasonically with a higher instrument gain or sensitivity level than will be used for the evaluation. It gives the operator an estimate of the welding quality and also makes all defects more prominent and less likely to be missed.

1.2.43 Search Unit

Device containing a piezoelectric material used for introducing vibrations into a material to be inspected or for receiving the vibrations reflected from the material. The active element of the search unit is defined as the effective transmitting area. Search units are also called transducers or probes. They may be single or dual and contain one or two piezoelectric

elements, respectively, for transmission and reception. The single search unit is sometimes enclosed in a transducer wheel or search unit wheel. The search unit may be manually handled and placed in direct contact with the material to be inspected or may be held in a fixture for immersion techniques.

1.2.44 Sensitivity

Measure of the ultrasonic equipment's ability to detect discontinuities. Quantitatively, it is the level of amplification of the receiver circuit in the ultrasonic instrument necessary to produce the required indication on the scope from the reference hole in the reference block. Also see "Standard Reference Level."

1.2.45 Shear Waves

Waves in which the particles within the material vibrate perpendicularly to the direction in which the wave travels or propagates. Also called transverse waves.

1.2.46 Shear Wave Inspection

Inspection technique using shear waves in a material. The search unit is placed at an angle to the contact surface of the material so the resultant refracted sound is a shear wave at an angle to the normal.

1.2.47 Standard Reference Level

Mid-screen height reflection when beaming at the 1.52 mm hole in the primary reference block or the reference hole in the secondary standard.

1.2.48 Surface Waves

Waves that propagate along the surface of the material and penetrate it to only about 1/2-wavelength. Also known as Rayleigh waves.

1.2.49 Test Frequency

Operating frequency in hertz per second of the search unit during period of activation. Frequency is usually expressed in megacycles per second or megahertz. The latter term has been adopted for international use and is preferred.

1.2.50 Video Form

Type of signal presentation on a CRT in which only the upper half of the signal appears.

1.3 GENERAL REQUIREMENTS

The procedures, methods, standards, and description of equipment specified herein shall be used for inspection of weldments. Ultrasonic inspections shall be made to detect the following defects:

a. Cracks or crack-like faults.

b. Root defects, including lack of penetration and fusion.

c. Lack of fusion between passes on the sidewall.

d. Porosity or inclusions and excessive undercutting.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Statements

Ultrasonic Inspection

Procedures and Methods. The pulse echo contact method with an A scan presentation shall be used for the ultrasonic inspection of welded joints except that immersion techniques may be used for some applications when approved by the Contracting Officer. The Contractor shall provide a standard reference block and working standards as described in paragraph REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION. The procedures to be used for personnel and equipment qualification, equipment calibration, and inspection, shall be submitted to the Contracting Officer at least 30 days prior to their intended use. Approval by the Government will in no way affect the obligation of the Contractor to employ qualified personnel, equipment, and procedures, and to perform the inspection as specified. The procedure description shall include the following:

a. Couplant.

b. Search unit characteristics including angle, size, shape, nominal frequency, type designation.

c. Method and type of wave.

d. Equipment and accessories including manufacturer, model number, date of manufacture, last date of calibration, and the manufacturer's electrical, physical, and performance specifications.

e. Decibel (dB) compensation system for distance-amplitude correction.

Records

Ultrasonic Inspection

Reports containing the following information:

a. Identification and Location of Inspected Item: Name and place of the inspected item, the person performing the inspection, and the date of inspection.

b. Detail of Inspections: Details of methods, types of waves used, search units, frequencies, inspection equipment identification, and calibration data with enough information to permit duplication of the inspection at a later date.

c. Response in Calibration: The response from the DSC or SC block used in calibration and for acceptance/rejection in terms of the response from the 1.524 mm (0.06 inch) reference hole in the standard IIW block (primary standard).

d. Identification of Unacceptable Areas: Locations, dimensions,

types, and area of unacceptable defects and discontinuities giving reflections over 50 percent of the reject/repair line. These may be noted on a sketch or marked-up drawing.

e. Record of Repair Areas: A record of repaired areas shall be furnished as well as test results for the repaired areas.

1.5 WAVE TYPES

The types of waves and the conditions under which they shall be used are specified below:

1.5.1 Shear Waves

Unless conditions prohibit, shear waves shall be used. A longitudinal wave procedure may be used instead, if approved by the Contracting Officer. Refracted waves between 40 degrees and 70 degrees shall be used except where different angles are indicated in approved procedures, such as for materials less than 13 mm thick, for materials with sound velocities greater than in steel, when the weldments are not readily accessible, or when existing backing rings or backing strips are not removed. For inspection of weldments containing backing rings or backing strips, the instrument shall be adjusted and the refracted angles shall be selected in a way to separate the weldment and the backing ring reflections. The search unit angle and the resulting shear wave angle in the material to be inspected shall be established by the Contractor for each application and this information shall be included in the procedure submitted for approval.

1.5.2 Longitudinal Waves

When conditions prohibit the use of shear waves, longitudinal waves may be used. The procedure shall be specially developed to suit the application and shall have the prior approval of the Contracting Officer.

1.6 CHANGES IN PROCEDURE

Should application of an approved procedure not provide for good resolution or adequate ultrasonic penetration in the items to be inspected (see paragraph EQUIPMENT QUALIFICATION REQUIREMENTS), changes in procedure or equipment such as frequency, pulse repetition rate, angle of search unit, couplant, or oscilloscope shall be made by the Contractor. Adequacy of the new procedure shall be demonstrated to the Contracting Officer. The Government reserves the right to require a change in test equipment during these tests if any of the following test system characteristics fall below the levels listed in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS: sensitivity, amplitude and distance linearity, signal-to-noise ratio, entry and back surface resolution and penetration.

1.7 ULTRASONIC EQUIPMENT

The ultrasonic equipment shall conform to the requirements listed in AWS D1.1 Section Inspection, subsection Ultrasonic Equipment, with the following exceptions:

a. The ultrasonic test instruments shall be able to generate, receive, and to present pulses in the frequency range from 1 to 10 megahertz (MHz).

b. The horizontal linearity of the ultrasonic instrument shall be

measured in accordance with paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

c. In addition to the resolution test specified in AWS D1.1, subsection Ultrasonic Equipment, both near- and far-surface resolution tests shall be conducted in accordance with the tests specified for these characteristics in the paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.8 PERSONNEL QUALIFICATION AND REQUIREMENTS

1.8.1 Personnel Qualification

The three levels of responsibility associated with ultrasonic inspection are defined in ASNT-01. For qualification to perform ultrasonic inspection, personnel shall be certified under ASNT-01 and ASNT-04within a period of 1 year before the date of contract. Other qualification or certification may be accepted at the Contracting Officer's discretion. Personnel with only an operator or inspector trainee certification will not be considered qualified to pass judgement on the acceptability of inspected items, but may work under the direct supervision of a qualified ultrasonic inspector. Qualified ultrasonic inspectors shall be able to judge the acceptability of the item in accordance with paragraph ACCEPTANCE/REJECTION LIMITS.

1.8.2 Examinations

If the Contracting Officer doubts an individual's ability as an operator, inspector, or supervisor, the individual shall be recertified in accordance with ASNT-01. At the option of the Government, the Contracting Officer may participate in administering the examination and in evaluating the results.

1.9 REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION

Reference standards shall be used to calibrate the inspection equipment, test its operating condition, and record the sensitivity or response of the equipment during the inspection in accordance with paragraph EQUIPMENT QUALIFICATION REQUIREMENTS. The standards shall comprise a standard reference block and reference specimens as noted below.

1.9.1 Standard Reference Block

The standard reference block or primary standard shall be provided by the Contractor and shall consist of the IIW block in AWS D1.1, Section Inspection, subsection Reference Standards. The standard reference block also shall be used in any reinspection on the same basis as the original inspection, even though the reinspection is to be performed by other ultrasonic instruments and accessories.

1.9.2 Working Standards

The Contractor may use other recognized working standards detailed with the IIW block in AWS D1.1 such as the Sensitivity Calibration (SC) block. However, such blocks must be referenced to the IIW block as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS. Details of their use must be included in the procedure description submitted to the Contracting Officer. These blocks are the secondary standards. They shall be of acoustically similar material to the welds to be inspected. The secondary standards shall be suited for the applicable

tests specified in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS and shall be used as follows, except where the IIW block is specifically required:

a. To assure adequate penetration of the base material.

b. To provide a secondary field standard.

c. To calibrate the equipment and establish the standard reference level.

1.9.3 Resolution Test Block

The Contractor shall furnish a resolution test block in accordance with the details shown in AWS D1.1 Section Inspection, subsection Ultrasonic Equipment.

1.10 EQUIPMENT QUALIFICATION REQUIREMENTS

The ultrasonic instrument and accessories shall be evaluated on their arrival at the jobsite just before the start of inspection. They shall be evaluated using the Contractor's furnished primary standard and shall meet or exceed the requirements listed in paragraphs under EQUIPMENT QUALIFICATION REQUIREMENTS. Equipment that does not meet these requirements shall not be used in the inspection.

1.10.1 Requalifications

The equipment shall be requalified after normal use at intervals not to exceed 40 hours except as noted. The equipment also shall be requalified immediately after maintenance or repair or when the Contracting Officer considers its operation questionable.

1.10.2 Longitudinal Wave System

1.10.2.1 Vertical Amplitude Linearity

Two adjacent reflections of different amplitudes obtained through the thickness of the primary or secondary standard shall vary in the same proportion as the amplitude of the first reflection is increased in discrete 2-dB increments between 20 percent and 80 percent to full screen height. For each gain setting, the amplitude of each reflection shall vary by the same factor within plus or minus 5 percent. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.10.2.2 Horizontal Linearity

The first three multiple reflections obtained through the thickness of the primary or secondary standard shall be equally spaced within plus or minus 5 percent when spread over 90 percent of the sweep length. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.10.2.3 Near-Surface Resolution

Excessive ringing that appears on the CRT to the right of the sound entry point is not to exceed a 13 mm (1/2 inch) equivalent distance in steel with the search unit placed on the 100 mm (4 inch) edge of the IIW (primary) block and positioned for maximum amplitude reflection from the

1.524 mm (0.06 inch) reference hole of the primary standard. The reference reflector shall be set to mid-screen and the gain shall be increased 20 dB. The reference hole located at least 13 mm (1/2 inch) from one edge of the AW DSC or SC secondary standard shall be used similarly. Acceptability shall be on the same basis as in the primary standard.

1.10.2.4 Far-Surface Resolution

This property of the equipment will be verified by the method detailed in AWS D1.1, Section Inspection, subsection Calibration of the Ultrasonic Unit with the IIW or Other Approved Calibration Blocks. In addition, the trailing edge of the third reflection shall return to the sweep line and be clearly discernible.

1.10.3 Angle Wave System

1.10.3.1 Vertical (Amplitude) Linearity

Two adjacent multiple reflections from the 1.524 mm reference hole in the primary standard shall vary in the same proportion as the amplitude of the first reflection in discrete 2-dB increments between 20 percent and 80 percent of full screen height. For each gain setting, the amplitude of each adjacent reflection shall vary within plus or minus 5 percent. For testing with the AWS SC or AWS DSC secondary standard, the same criteria shall apply. For the SC block, the transducer shall be placed on the longitudinal surface contiguous with the sound entry point lines whereas the 100 mm longitudinal surface of the DSC block shall be used for the same purpose. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.10.3.2 Horizontal Linearity

The first three multiple echoes obtained from the 1.524 mm reference hole of the primary standard or from the reference hole in a secondary standard with the transducer positioned at a minimum of 25 mm sound path distance shall be equally spaced plus or minus 5 percent when spread over 90 percent of the sweep length. The gain shall be adjusted to give a mid-screen height first reflection. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.10.3.3 Near-Surface Resolution

The search unit shall be positioned for maximum amplitude using the primary or secondary standard as in the horizontal linearity test. The gain shall be adjusted to give a mid-screen height first reflection and then shall be increased 20 dB. Excessive ringing that appears on the CRT to the right of the sound entry point is not to exceed 13 mm equivalent distance in steel.

1.10.3.4 Far-Surface Resolution

The equipment shall delineate the three resolution holes in the resolution block appropriate for the angle of the transducer to be used in the inspection.

1.10.3.5 Signal-to-Noise Ratio

With the search unit located as in the horizontal linearity test, the gain shall be set to obtain an 80 percent full screen height first reflection. The reference reflection-to-noise-amplitude ratio shall not be less than 10

to 1.

1.10.3.6 Exit Point

The search unit shall be placed on the graduated scale on the 300 mm edge of the primary standard and the ultrasound shall be beamed toward the curved edge of the block. The gain shall be set for a mid-screen first reflection. The search unit shall be moved back and forth until the first reflection is maximized. The index line on the side of the search unit shall be within 1.6 mm of the mid-point of the graduated scale in either direction. Requalification is required after 40 hours or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.10.3.7 Transducer Angle

The established exit point of the probe shall be set over the applicable angle index line scribed on the 200 mm or 300 mm edge, as appropriate, of the primary standard. The gain shall be set to obtain a mid-screen first reflection from the 50 mm plexiglass-lined hole for search units up to 70 percent with the search unit placed on the 200 mm edge. Search units of large angles that have been approved specifically by the Contracting Officer shall be tested from the 300 mm edge using the 1.524 mm reference hole. The search unit shall be moved back and forth to maximize the first reflection. When the material to be inspected is not acoustically similar to the primary standard, the inspection angle shall be within plus or minus 2 degrees of the angle specified in the approved procedure. Requalification is required after 40 hours or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.11 SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS

Sensitivity calibration shall be done immediately after a change of operators and at least every 30 minutes thereafter as testing proceeds. Recalibration shall also be required after any power interruption, including a change of source, when the equipment is suspected of being in error, or after relocation of the jobsite. The 30-minute and relocation calibrations may coincide. Before calibration, the instrument shall be allowed to warm up before calibration is attempted. The instrument range and delay controls shall be adjusted to display signals from the reference hole in the primary (IIW block) or secondary standard (DSC or SC block or both) on the viewing screen for the range of distances to be inspected.

1.11.1 Calibration Procedure

The test instrument shall be calibrated as described below.

1.11.1.1 Longitudinal Wave System

In calibrating with the primary standard, the transducer shall be positioned on the 100 mm edge for maximum reflection from the 1.524 mm reference hole. The gain shall be adjusted so that the first reflection is at 50 percent full scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. If a secondary standard is to be used in the inspection, the reject/repair line will be established similarly. For the DSC block, the transducer shall be positioned on the 100 mm long surface and with the SC degrees sound entry point lines. Adjustment for loss of signal due to distance shall be

compensated for as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS.

1.11.1.2 Angle Wave System

In calibrating with either the primary or secondary standard, the transducer shall be positioned on the same surfaces as in the case of the longitudinal wave system but over the sound entry point lines appropriate for the angle of the transducer to be used in the inspection. The gain shall be adjusted to give a first reflection that is 50 percent of full-scale response. The top of that indication shall be marked with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. Loss of signal shall be compensated as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS.

1.11.2 Calibration of the Secondary Standards

After adjusting the first reflection from the reference hole in the secondary standard to 50 percent full-scale response for a sheer or longitudinal wave inspection, a maximized reflection from the 1.524 mm reference hole in the primary standard shall be obtained without changing the gain setting. Then this gain setting shall be readjusted to obtain a 50 percent full-scale reflection and the readjusted setting shall be recorded as required by paragraph SUBMITTALS, Records, to provide a basis for recalibration when the secondary standard is unavailable.

1.11.3 Equipment With a Calibrated Gain Control (Attenuator)

When a calibrated gain control attenuator is used, the transducer shall be positioned for a maximum reflection from the reference hole in the secondary standard representing approximately 1/2 the longest inspection distance. This reflection shall be adjusted to mid-scale by varying the gain control accordingly. The difference in decibels between this amplitude and the signal obtained from the first, second, and longest distance reflection obtainable on the secondary standard shall be measured. The differences shall be recorded and plotted on a curve to determine the necessary correction to the amplitude at the various inspection distances. A level (80 percent of the primary level) obtained from the corrected signal heights is equivalent to the reject/repair line.

1.11.4 Equipment With Electronic Distance Compensation Circuitry

If the difference in amplitude between the first reflection and the reflection obtained from the maximum inspection distance is 1 dB or less, the instrument may be used as is. If not, the procedure used for equipment with a calibrated decibel control must be used to determine the necessary correction to the reflections obtained at the various inspection distances. This characteristic of the equipment must be reexamined on a monthly basis or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS and correction factors must be modified accordingly.

1.11.5 Longitudinal Wave Distance-Amplitude Correction Curve

A distance-amplitude correction curve may be used instead of the calibrated gain control or the electronic circuitry for either the shear or longitudinal wave system as described below:

a. A shear wave distance-amplitude correction curve shall be constructed and drawn on the face of the cathode ray tube (CRT) for inspection of weldments in excess of 38 mm thick when the design of the test equipment permits. The reference hole in the secondary standard SC shall be used to construct the distance-amplitude correction curve for a minimum of three node points, 1, 2, and 3. The sensitivity of the instrument shall be adjusted to produce 50 percent full-scale response for the maximized primary reflection and the reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve.

b. A longitudinal wave distance-amplitude correction curve shall be constructed and drawn on the face of the CRT when longitudinal waves are to be used in the inspection for material thicknesses exceeding 25 mm, if design of the test equipment permits. The reference hole in the secondary standard shall be used. Instrument sensitivity shall be adjusted to 50 percent full-scale of the maximized response from the reference hole at 1/2-maximum inspection distance. A reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve. The reflection amplitudes to define this curve shall be taken from the faces of the secondary sensitivity standards which are 25 mm, 50 mm, and 1/2-maximum inspection distance, and the longest distance obtainable from the secondary standard, respectively, from the reference hole. When a correction curve cannot be drawn on the face of the CRT, one of the distance-amplitude correction methods noted above and submitted under the procedure description in accordance with paragraph GENERAL REQUIREMENTS shall be applied.

1.11.6 Longitudinal Wave Inspections Using Immersion Technique

The reference hole in a secondary standard shall be used for each different inspection distance. Repair/reject limits shall be established by immersing both the search unit and secondary standard in the liquid bath in which the inspection is to be conducted. The procedure noted below shall be used:

a. The longitudinal waves from the search unit shall be directed toward the face of the secondary standard closest to the reference hole.

b. The search unit shall be positioned for maximum response. The amplitude of reflection shall be adjusted to 50 percent full-scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair point. The above shall be repeated for each different surface-to-hole distance to establish the reject/repair line.

c. With the gain at the same setting and the primary standard and search unit in air, a maximized reflection shall be obtained from the 1.524 mm reference hole in the primary standard (IIW). Then, this gain setting shall be readjusted to obtain a 50 percent full-scale reflection. The readjusted setting shall be recorded as required by paragraph SUBMITTALS, Records, to provide a basis for recalibration when the secondary standard is unavailable.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 PREPARATION OF MATERIALS FOR INSPECTION

Surfaces shall be free from the following:

3.1.1 Weld Spatter

Spattering or any roughness that interferes with free movement of the search unit or impairs transmission of the ultrasonic vibrations.

3.1.2 Irregularities

Those which could mask or be confused with defect indications.

3.1.3 Weld Backing Strips

Strips that are not to remain in place shall be removed and all sharp edges and valleys shall be eliminated by grinding or other mechanical means.

3.1.4 Dirt

All loose scale, rust, paint, and dirt shall be removed from the coupling surface.

3.2 INSPECTION PROCEDURE

When possible, all welds shall be examined from both sides of the weld and from one surface. If complete inspection cannot be accomplished from one surface, inspection shall be made from another surface that is part of the same joint. Preliminary scanning techniques using an increased instrument gain shall be used to locate possible defects. When possible, gain shall be increased to a minimum of twice (6 dB) the reference level setting. Final acceptance or rejection shall be evaluated with the equipment properly calibrated and the gain control set at the reference level. The reject/repair line shall be used to evaluate quality of the weld. If a periodic calibration check shows that the equipment is not operating properly or that the system's sensitivity has decreased more than 20 percent (2 dB) from the established sensitivity level, all welds inspected since the prior calibration shall be reexamined. If penetration of the shear waves is questionable, the angle search unit shall be placed in position on one side of the weldment with the waves directed through the weldment. A disconnected angle search unit, plastic or metal wedge or disk, or any good reflector shall be placed in the wave path of the search unit on the far side of the weld to reflect the sound. When good reflections cannot be obtained by either shear or longitudinal waves, the Contractor shall modify the procedures in accordance with paragraph GENERAL REQUIREMENTS.

3.2.1 Test Frequency

The test frequency for ferrous materials shall be as specified in AWS D1.1, Section Inspection, subsection Ultrasonic Equipment, except for thicknesses below 13 mm, frequencies between 2.25 and 5 MHz may be used to obtain increased sensitivity. For materials that are difficult to penetrate, any frequency within the operating range of the equipment may be used. The effective depth of penetration and sound beam divergency shall be demonstrated to the Contracting Officer.

3.2.2 Couplants

The choice of couplant is optional with the Contractor except as follows:

a. The couplant shall be the same as that used for equipment qualification and calibration.

b. Couplants that may corrode the reference standards and material being tested or leave objectionable residues shall not be used.

c. Oils shall not be used in systems intended to handle liquid oxygen.

d. Couplants shall be of the proper viscosity to give good coupling for the surface roughness.

3.2.3 Shear Wave Inspection

Shear wave inspection shall be performed as follows: The search unit shall be placed on the contact surface at a distance from the weld equal to that used when calibrating the equipment.

3.2.4 Longitudinal Flaws

To detect longitudinal flaws, the search unit shall be slowly moved toward and away from the weld far enough to cover its entire cross section, approximately 90 degrees to the weld centerline. The search unit shall be radially oscillated to the left and right, covering an angle of approximately 30 degrees. During the foregoing movement, the search unit shall be continually advanced parallel to the weld centerline. The rate of movement shall depend on the operator's ability to clearly see and identify all reflections. The amount of movement shall be calculated to insure that the inspection distance will be great enough to traverse the weld.

3.2.5 Transverse Flaws

To detect transverse flaws when the welded surface is ground flush, the search unit shall be moved along the welded surface in each direction parallel to the centerline of the weld metal with the wave radiating parallel to the weld centerline. To detect transverse flaws when the welded surface is not ground flush, the search unit shall be moved parallel to the weld in each direction, on the adjacent base metal at the top of the weld, with the wave directed at an angle of 30 degrees to the weld centerline.

3.2.6 Longitudinal Wave Inspection

This inspection shall be made as follows:

a. The search unit shall be placed on the contact surface with the wave directed in a straight line through any intervening base metal and through the weldment.

b. The search unit shall then be moved slowly in a direction parallel to the weld centerline and zigzagged across an area equivalent to the welded thickness to make sure that waves penetrate the entire welded cross section.

c. The rate of movement shall be dependent on the operator's ability

to clearly see and identify all reflections.

3.3 GENERAL ACCEPTANCE/REJECTION REQUIREMENTS

Discontinuities shall be evaluated only when the ultrasonic equipment is calibrated properly. If discontinuities are detected, the sound beam shall be directed to maximize the signal amplitude. To determine the length of a discontinuity, the search unit shall be moved parallel to the discontinuity axis in both directions from the position of maximum signal amplitude. One-half the amplitude or a 6-dB increase in sensitivity from a point at which the discontinuity signal drops rapidly to the baseline shall be defined as the extremity of the discontinuity. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. For discontinuities with signal amplitudes exceeding full screen height, 50 percent of full screen shall be considered half-peak amplitude. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. The maximum signal amplitude, length, depth, and position within the inspection zone shall be determined and reported for discontinuities yielding a signal amplitude equal to or exceeding the reject/repair line. The minimum recordable length of a discontinuity shall be 3 mm. When evaluating welds joining two members with different thicknesses at the weld, the thickness T shall be the lesser of the two thicknesses. The criteria for acceptance or rejection based on ultrasonic inspection will supplement a visual inspection. The sizes and surface conditions of the welds shall conform to the requirements indicated on the applicable plans and drawings and other sections of the specification.

3.3.1 Investigation of Questionable Indications

An indication considered doubtful shall be brought to the attention of the Contracting Officer and, at the Contractor's option, the weld shall be repaired or investigated further. Indications detected within 10 mm of accessible surfaces shall be investigated further using liquid penetrant in accordance with ASTM E 165 or magnetic particle methods in accordance with ASTM E 709, as applicable, to determine if the surface is penetrated. Failure to locate the flaws by one of these methods shall necessitate further investigation by the other. For nonmagnetic materials, only dye penetrant inspection is required. Other questionable defects shall be further investigated using modifications of the inspection procedure in accordance with paragraph GENERAL REQUIREMENTS.

3.3.2 Inspection of Repairs

All repairs shall undergo the same inspection procedure that originally revealed the discontinuities. Before acceptance, the welds shall meet the standards required for the original weld.

3.4 ACCEPTANCE/REJECTION LIMITS

Welds shall be accepted or rejected by ultrasonic indication in accordance with the following:

3.4.1 Full Penetration Butt Welds and Corner Welds

3.4.1.1 NOT USED

3.4.1.2 NOT USED

3.4.1.3 Class III

Welds shall be rejected on the basis of the following:

a. Any discontinuity with a reflection exceeding the established reject/repair line and with a length exceeding 13 mm. Adjacent discontinuities separated by sound metal with a dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity.

b. Any discontinuity with a reflection equal to or exceeding 50 percent of the reject/repair line or with the level 8 dB more than the reject/repair line and with a length (L) exceeding 50 mm or LT, whichever is greater.

c. If the total cumulative length of discontinuities in any 300 mm of weld length exceeds 75 mm or 2 T, whichever is greater, that weld length shall be rejected.

3.4.2 Full Penetration Tee Welds

Full Penetration Tee Welds (for Incomplete Root Penetration): Any discontinuity with the reflection exceeding the established reject/repair line of the applicable class shall be rejected. Any discontinuity with a reflection exceeding 25 percent of the established reject/repair line up to and including the reject/repair line shall be rejected if its length exceeds 1/2 T in a direction transverse to the axis of the weld or LT parallel to the axis for all classes. If the total cumulative length of discontinuities in any 300 mm of weld length exceeds the limits of the applicable class, that weld length shall be rejected.

3.4.3 Partial and Full Penetration Tee Welds

Partial and Full Penetration Tee Weld Boundaries: The depth of weld penetration and weld cross section width at the through member surface shall be as indicated by applicable plans or drawings. Limits of discontinuities shall be as specified in preceding paragraphs.

3.4.4 Tee Weld Discontinuities

Such discontinuities extending into the through member shall be rejected if reflection exceeds the established reject/repair line.

-- End of Section --

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
AISC ASD/LRFD Vol II	(1992) Manual of Steel Construction Vol II: Connections

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1996b) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563M	(1993) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(1994c) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(1996) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1	(1994) Lock Washers (Inch Series)
ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(1996) Structural Welding Code - Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Manual Vol II. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC ASD Manual and AISC ASD/LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1. High-strength bolting shall be in accordance with AISC ASD Manual.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Drawings

Structural Steel System; Structural Connections.

Shop and erection details including members (with their connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.

Statements

Erection

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.

Certificates

Mill Test Reports

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation.

Welder Qualifications

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

Fabrication

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 36/A 36M.

2.1.2 High-Strength Low-Alloy Steel

High-strength low-alloy steel shall conform to ASTM A 572/A 572M, Grade 345.

2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade B.

2.3 STEEL PIPE

Steel pipe shall conform to ASTM A 53, Type E, Grade B.

2.4 NOT USED

2.5 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325M , Type 1 with carbon steel nuts conforming to ASTM A 563M, Grade C.

2.6 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563M , Grade A.

2.7 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Heavy Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325M bolts.

2.8 WASHERS

Plain washers shall conform to ASTM F 844. Other types, when required, shall conform to ASME B18.21.1, ASTM F 436M or ASTM F 959.

2.9 PAINT

Paint shall conform to SSPC Paint 25.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC quality certification program for Category I structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with AISC ASD Manual and primed with the specified paint.

3.2 ERECTION

Erection of structural steel shall be in accordance with the applicable provisions of AISC ASD Manual.

3.2.1 Structural Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Field welded structural connections shall be completed before load is applied.

3.2.2 Base Plates and Bearing Plates

Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2.3 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

-- End of Section --

SECTION 05210

STEEL JOISTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

STEEL JOIST INSTITUTE (SJI)

SJI-01	(1994) Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Drawings

Steel Joists

Detail drawings shall include fabrication and erection details, specifications for shop painting, and identification markings of joists.

Certificates

Steel Joists.

Certificates stating that the steel joists have been designed and manufactured in accordance with SJI-01. Complete engineering design computations may be submitted in lieu of the certification.

1.3 DESCRIPTION

Steel joists are designated on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition and stored off the ground in a well drained location, protected from damage, and easily accessible for inspection and handling.

PART 2 PRODUCTS

2.1 OPEN WEB STEEL JOISTS

Open web steel joists shall conform to SJI-01, K-Series. Joists shall be designed to support the loads given in the standard load tables of SJI-01.

2.2 NOT USED

2.3 NOT USED

2.4 ACCESSORIES AND FITTINGS

Accessories and fittings, including end supports and bridging, shall be in accordance with the standard specifications under which the members were designed.

2.5 SHOP PAINTING

Joists and accessories shall be shop painted with a rust-inhibiting primer paint. For joists which will be finish painted under Section 09900 PAINTING, GENERAL, the primer paint shall be limited to a primer which is compatible with the specified finish paint.

PART 3 EXECUTION

3.1 ERECTION

Installation of joists shall be in accordance with the standard specification under which the member was produced. Joists shall be handled in a manner to avoid damage. Damaged joists shall be removed from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Joists shall be accurately set, and end anchorage shall be in accordance with the standard specification under which the joists were produced. Joist bridging and anchoring shall be secured in place prior to the application of any construction loads. Any temporary loads shall be distributed so that the carrying capacity of any joist is not exceeded. Loads shall not be applied to bridging during construction or in the completed work. Abraded, corroded, and field welded areas shall be cleaned and touched up with the same type of paint used in the shop painting.

-- End of Section --

SECTION 05300

STEEL DECKING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-01	(1986; Addenda 1989) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 611	(1994) Steel, Sheet, Carbon, Cold-Rolled, Structural Quality
ASTM A 653	(1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 792	(1995) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3	(1989) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI-02	(1987; Amended 1991) Diaphragm Design Manual
SDI Pub No 28	(1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Data

Deck Units

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

SD-04 Drawings

Deck Units; Accessories;
Attachments; Holes and Openings

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded or fastener connections; and the manufacturer's erection instructions.

Certificates

Deck Units; Attachments

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

Statements

Attachments

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No 28. Panels of maximum possible lengths shall be used to minimize end laps. Fabricate deck units in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI-01, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.1.1 Roof Deck

Steel deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 653, ASTM A 611 or ASTM A 792. Roof deck units shall be

fabricated of the steel design thickness required by the design drawings and shall be shop painted.

2.2 TOUCH-UP PAINT

Touch-up paint for shop-painted units shall be of the same type used for the shop painting. Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

2.4.2 NOT USED

2.4.2.1 Cover Plates to Close Panels

Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in composite steel deck may receive a tape joint cover.

2.4.2.2 NOT USED

2.4.2.3 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 1.204 mm other metal accessories, 0.909 mm unless otherwise indicated. Accessories shall include but not be limited to saddles, butt cover plates, underlapping sleeves, and ridge and valley plates.

PART 3 EXECUTION

3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI-02 and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being

permanently secured in place. The deck shall not be used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

3.2 NOT USED

3.3 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 16 mm diameter puddle welds or fastened with screws, powder-actuated fasteners or pneumatically driven fasteners to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 28. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall not be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. "Blow holes" created by welding shall be repaired or replaced in accordance with the deck manufacturer's recommendations as directed by the Cotnracting Officer at no expense to the government. Holes and similar defects will not be acceptable. Deck ends shall be lapped 50 mm. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI-02. Powder-actuated fasteners shall be driven with a low-velocity piston tool by an operator authorized by the manufacturer of the piston tool. Pneumatically driven fasteners shall be driven with a low-velocity fastening tool and shall comply with the manufacturer's recommendations.

3.4 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 150 mm across require no reinforcement. Holes and openings 150 to 300 mm across shall be reinforced by 1.204 mm thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Holes and openings larger than 300 mm shall be reinforced by L76 x 76 x 6.4 steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists. Openings must not interfere with seismic members such as chords and drag struts.

-- End of Section --

SAFETY PAYS

Modular Design System

SECTION 05400

COLD FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Load bearing cold formed steel stud exterior wall.

1.2 NOT USED

1.3 RELATED SECTIONS

A. Section 05120 - Structural Steel

B. Section 05311 - Steel Roof Deck: Metal roof decking

C. Section 06114 - Wood Blocking and Curbing: Rough wood blocking

D. Section 07213 - Batt and Blanket Insulation: Insulation within framing members

E. Section 07900 - Joint Sealers

F. Section 09111 - Metal Stud Framing System - Interior partitions

G. Section 09206 - Metal Furring and Lathing

H. Section 09260 - Gypsum Board Systems: Light weight, non-load bearing metal stud framing

I. Section 09511 - Suspended Acoustical Ceilings: Ceiling suspension system

1.4 REFERENCES

A. AISI - American Iron and Steel Institute - Cold-Formed Steel Design Manual.

B. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process, Physical (Structural) Quality.

D. ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

E. ASTM A570 - Hot-Rolled Carbon Steel Sheet and Strip. Structural Quality.

F. ASTM A611 - Steel, Cold-Rolled Sheet, Carbon, Structural.

G. ASTM A645 - Steel Sheet, Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated.

H. ASTM C955 - Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.

I. AWCI (Association of Wall and Ceiling Industries) -Specifications Guide for Cold Formed Steel Structural Members.

J. AWS D1.1 - Structural Welding Code.

K. AWS D1.3 - Light Steel Welding Code.

L. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

M. MFMA (Metal Framing Manufacturers Association) - Guidelines for the Use of Metal Framing.

1.5 SYSTEM DESCRIPTION

A. Maximum Allowable Deflection: h/600 span.

B. Design wall system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

C. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.6 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, and accessories or items required of related work. Indicate stud layout. Describe method for securing studs to tracks and for bolted and welded framing connections.

B. Calculations: Provide calculations for loadings and stresses of wall system and connections under the Professional Structural Engineer's seal.

C. Product Data: Provide data on standard framing members; describe materials and finish, product criteria and limitations.

1.7 QUALITY ASSURANCE

A. Calculate structural properties of framing members in accordance with AWCI, MFMA, and AWS D1.3 requirements.

B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with minimum 5 years experience.

B. Design structural elements under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.10 COORDINATION

Modular Design System

A. Coordinate with the placement of components within the stud framing system, specified in Section 08900.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Dale/Incor Industries, Dearborn, MI: Steel Framing

B. Clark Steel Framing Systems, Cincinnati, OH: Steel Framing

C. Unimast Incorporated, Franklin Park, IL: Steel Framing

2.2 FRAMING MATERIALS

A. Studs: ASTM A446, A570, A611, formed to channel shape, punched web, knurled faces; 1.6 mm thick, 63.5 mm face and 150 mm depth and 41 mm face and 100 mm depth.

A. Track: Formed steel; channel shaped; same width as studs, tight fit; 1.2 mm thick, solid web.

2.3 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, 1.6 mm thickness.

A. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered.

C. Touch-Up Primer for Galvanized Surfaces: SSPC - Paint 20 Type II Organic zinc rich.

2.4 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A123, hot dip galvanized to 380 gm/sq m.

B. Anchorage Devices: Power actuated.

C. Welding: In conformance with AWS D1.1 and AWS D1.3.

2.5 FABRICATION

A. Fabricate assemblies of sizes and profiles required; with framing members fitted, reinforced, and braced to suit design requirements.

B. Fit and assemble in largest practical sections for delivery to site, ready for installation.

2.6 FINISHES

A. Studs: Galvanize to G90 coating class.

B. Tracks and Headers: Galvanize to G90 coating class.

C. Bracing, Furring, Bridging: Same finish as framing members.

D. Plates, Gussets, Clips: Same finish as framing members.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that building framing components are ready to receive work.

3.2 ERECTION OF STUDDING

A. Install components in accordance with manufacturer's instructions.

B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 600 mm oc.

C. Place studs at 400 mm oc; not more than 400 mm from abutting walls and at each side of openings. Connect studs to tracks using fastener method.

D. Construct corners using minimum three studs. Double stud wall openings, door and window jambs.

E. Erect load bearing studs one piece full length. Splicing of studs is not permitted.

F. Erect load bearing studs, brace, and reinforce to develop full strength, to achieve design requirements.

G. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

H. Install intermediate studs above and below openings to align with wall stud spacing.

I. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

J. Attach furring channels to studs for attachment of fixtures anchored to walls.

K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

L. Touch-up field welds and damaged galvanized surfaces with primer.

M. Complete framing ready to receive preformed metal siding.

3.3 ERECTION TOLERANCES

A. Maximum Variation from True Position: 3 mm.

B. Maximum Variation of any Member from Plane: 3 mm.

END OF SECTION

SECTION 05500

MISCELLANEOUS METAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1980; R 1993) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 653	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924	(1996a) Steel Sheet, Metallic-Coated by the Hot-Dip Process

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-344	(Rev B) Lacquer, Clear Gloss, Exterior, Interior

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(1993) Metal Bar Grating Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES

Drawings

Miscellaneous Metal Items

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items:

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 653, or ASTM A 924, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have hand sanded or machine finish to a 240 grit. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for

items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.

1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 NOT USED

2.2 NOT USED

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 GUARDS POSTS

Guard posts shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, black finish.

2.8 DOWNSPOUT BOOTS

Downspout boots shall be cast iron with receiving bells sized to fit downspouts.

2.9 NOT USED

2.10 NOT USED

2.11 FLOOR GRATINGS AND FRAMES

Carbon steel and aluminum gratings shall be designed in accordance with NAAMM MBG 531 to meet the indicated load requirements. Edges shall be banded with bars 6 mm less in height than bearing bars for grating sizes above 19 mm. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Steel floor gratings and frames shall be galvanized after fabrication.

2.12 FLOOR PLATES

Floor plates shall be of thickness indicated and shall be galvanized.

2.13 NOT USED

2.14 HANDRAILS

Handrails shall be designed to resist a concentrated load of 890 N in any direction at any point of the top of the rail or 292 Newtons per meter applied horizontally to top of the rail, whichever is more severe.

2.14.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails, including inserts in concrete, shall be steel pipe conforming to ASTM A 53. Steel railings shall be 40 mm nominal size. Railings shall be shop primed, field painted. Pipe collars shall be steel.

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 10 mm hexagonal recessed-head setscrews.

(2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 150 mm long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Removable sections, toe-boards, and brackets shall be provided as indicated.

2.15 NOT USED

2.16 NOT USED

2.17 NOT USED

2.18 MIRROR FRAMES

Frames for plate glass mirrors larger than 450 by 750 mm shall be fabricated from corrosion-resisting steel with satin finish. Frames shall be provided with concealed fittings and tamperproof mountings.

2.19 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

2.20 NOT USED

2.21 NOT USED

2.22 NOT USED

2.23 NOT USED

2.24 NOT USED

2.25 NOT USED

2.26 STEEL STAIRS

Steel stairs shall be complete with structural channel stringers, grating treads, landings, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36. Stairs and accessories shall be shop primed. Gratings for treads and landings shall conform to NAAMM MBG 531. Grating treads shall have slip-resistant nosings.

2.27 NOT USED

2.28 TRENCH COVERS, FRAMES, AND LINERS

Trench covers shall be designed to meet the indicated load requirements. Trench frames and anchors shall be all welded steel construction designed to match cover. Covers shall be secured to frame, and shall be raised-tread, or steel floor plate or cast-iron grating as indicated. Grating opening widths shall not exceed 25 mm.

2.29 BATTERY RACK

Battery rack shall conform to the following:

a. Manufacturer: Aicken strut a Subsidiary of Robroy Industries, Rive Road, Verona, PA 15147, Phone 800-426-4293. Unistrut Corporation, 35660 Clinton Street, Wayne, Michigan 48184, Phone: 800-937-8788.

b. Channel framing shall be 1500 Series 38 mm standard duty Aicken strut, polyester type.

c. Shelf Units: Fiberglass reinforced polyester grating with a 67% open area with nominal square mesh pattern at 38 x 38 mm and 38 mm. All fasteners shall be constructed of reinforced polyurethane.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 NOT USED

3.3 NOT USED

3.4 NOT USED

3.5 INSTALLATION OF GUARD POSTS

Guard posts shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 21 MPa.

3.6 INSTALLATION OF DOWNSPOUT BOOTS

Downspouts shall be secured to building through integral lips with appropriate fasteners.

3.7 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.7.1 Installation of Steel Handrails

Installation shall be in pipe sleeves embedded in concrete and filled with molten lead or sulphur with anchorage covered with standard pipe collar pinned to post or by means of pipe sleeves secured to base plates bolted or welded to stringers or structural steel framework. Rail ends shall be secured by steel pipe flanges anchored by expansion shields and bolts.

3.8 NOT USED

3.9 NOT USED

3.10 NOT USED

3.11 NOT USED

3.12 NOT USED

3.13 NOT USED

3.14 NOT USED

3.15 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

-- End of Section --

SECTION 06114

WOOD BLOCKING AND CURBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Blocking in wall and roof openings.

B. Wood furring and grounds.

C. Concealed wood blocking for support of toilet and bath accessories and wall cabinets.

D. Telephone and electrical panel boards.

E. Preservative treatment of wood.

1.2 NOT USED

1.3 REFERENCES

A. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.

B. APA: American Plywood Association.

C. AWPA (American Wood Preservers Association) C1 - All Timber Products Preservative Treatment by Pressure Process.

D. AWPA (American Wood Preservers Association) C20 - Structural Lumber Fire Retardant Treatment by Pressure Process.

E. NFPA: National Forest Products Association.

F. SPIB: Southern Pine Inspection Bureau.

G. WCLIB: West Coast Lumber Inspection Bureau.

H. WWPA: Western Wood Products Association.

Modular Design System

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:
   1. Lumber Grading Agency: Certified by ALSC.
   2. Plywood Grading Agency: Certified by APA.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber Grading Rules: NFPA SPIB WCLIB WWPA.

B. Miscellaneous Framing: Stress Group D Southern Pine species, 19 percent maximum moisture content, pressure preservative treat.

C. Plywood: APA Structural I, Grade C-D with exterior glue; Exposure Durability 1; sanded.

2.2 ACCESSORIES

A. Fasteners and Anchors:
1. Fasteners: Hot-dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.

2. Anchors: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt or ballistic fastener for anchorages to steel.

2.3 FACTORY WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA Treatment C1 using water borne preservative with 0.25 percent retainage.

PART 3 EXECUTION

3.1 FRAMING

A. Set members level and plumb, in correct position.

B. Place horizontal members flat, crown side up.

C. Space framing and furring 16 inches o.c.

3.2 SHEATHING (PLYWOOD)

Modular Design System

A. Secure sheathing to framing members with ends over firm bearing and staggered.

B. Install telephone and electrical panel boards with plywood sheathing material where required. Over size the panel by 12 inches on all sides.

3.3 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Brush apply one coat of preservative treatment on wood in contact with cementitious materials, roofing and related metal flashings. Treat site-sawn cuts.

C. Allow preservative to dry prior to erecting members.

3.4 SCHEDULES

A. Roof Blocking: S/P/F species, 19 percent maximum moisture content, pressure preservative treatment.

B. Telephone and Electrical Panel Boards: 3/4 inch thick, square edges, site brush applied preservative treated.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish carpentry items, other than shop prefabricated casework.

B. Hardware and attachment accessories.

1.2 NOT USED

1.3 RELATED SECTIONS

A. Section 08211 - Flush Wood Doors.

B. Section 09900 - Painting: Painting and finishing of finish carpentry items.

1.4 REFERENCES

A. ANSI A135.4 - Basic Hardboard.

B. ANSI A208.1 - Mat Formed Wood Particleboard.

C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

D. AWI - Quality Standards.

E. AWPA (American Wood Preservers Association) C2 - Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes - C9 - Plywood.

F. AWPA (American Wood Preservers Association) C20 - Structural Lumber Fire Retardant Treatment by Pressure Process.

G. BHMA A156.9 - Cabinet Hardware.

H. FS MMM-A-130 - Adhesive, Contact.

I. HPMA (Hardwood Plywood Manufacturer's Association) HP - American Standard for Hardwood and Decorative Plywood.

J. NEMA (National Electric Manufacturers Association) LD3 - High Pressure Decorative Laminates.

K. NHLA (National Hardwood Lumber Association).

L. PS 1 - Construction and Industrial Plywood.

M. PS 20 - American Softwood Lumber Standard.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, accessories, and to a minimum scale of 1 to 10.

B. Hardware Instruction: Provide instructions for attachment hardware and finish hardware.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with AWI Custom quality.

1.7 QUALIFICATIONS

A. Fabricator: Company specializing in fabricating the products specified in this section with minimum four years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well-ventilated areas, and protected from extreme changes in temperature and humidity.

B. Protect work from moisture damage.

Modular Design System

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings instructed by the manufacturer.

1.10 COORDINATION

A. Coordinate the work with plumbing and electrical rough-in, installation of associated and adjacent components.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Wood Particleboard: ANSI A208.1 Type 1; AWI standard, composed of wood chips, medium density, made with high waterproof resin binders of grade to suit application; sanded faces.

B. Pressure Preservative Treated Plywood: Wolman CCA Type C in accordance with AWPA Standard C9. Plywood for countertop substrate shall be min. 20 mm pressure treated at sink locations and as indicated on the drawings.

2.2 PLASTIC LAMINATE MATERIALS

A. Plastic Laminate: NEMA LD 3, GP - 50 General Purpose for horizontal surfaces and GP28. Color pattern and matte as selected.

B. Laminate Backing Sheet: .5 mm Backing Sheet grade, undecorated plastic laminate.

2.3 ADHESIVE

A. Adhesive: FS MMM-A-130 contact adhesive. Type recommended by laminate manufacturer to suit application.

2.4 FASTENERS

A. Fasteners: Of size and type to suit application; US32D

finish in concealed locations and same finish in exposed locations.

B. Concealed Joint Fasteners: Threaded steel.

2.5 ACCESSORIES

A. Lumber for Shimming, Blocking, and Birch: Softwood lumber of Douglas species.

B. Plastic Edge Trim: Extruded flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness; color as selected.

C. Primer: Alkyd primer sealer type.

D. Wood Filler: Solvent base, tinted to match surface finish color.

2.6 WOOD TREATMENT PROCESSES

A. Wood Preservative by Pressure Treatment (PT Type): AWPA Treatment C2 using water borne preservative with 0.25 percent retainage.

2.7 SHOP TREATMENT OF WOOD MATERIALS

A. Shop pressure treat treatment to wood materials requiring preservatives to concealed wood blocking.

B. Redry wood after pressure treatment to maximum 6-10 percent moisture content.

2.8 HARDWARE

A. Hardware: BMHA A 156.9 as follows:
1. Hinges: Euro-style hinge with concealed knuckle; 170 degrees swing with self closing capability at less than 90 degrees to its closed position; clip concealed hinge shall pass Section 4.2; 4.3 (hinge operating life test) and 4.3 (Self Closing Hinge Test) of ANSI/BHMA A 156.9.

Hinges to be nickel plated.

2. Pulls: Wire pulls with center to center dimension of 90 mm, outer dimension of 8 mm in diameter, and a projection of 35 mm. The wire pulls shall be stainless steel in a US32D finish.
3. Latches are not required due to the type of hinges specified. Select latches only when seismic condition warrant their use.
4. Shelf Standards are 16 mm in width and 5 mm of an inch in height. This type of standard is used where shelves are supported along the two ends. There shall be four vertical standards for support. Standards shall be recessed in the vertical walls of the casework. Appropriate shelf supports with rubber cushion shall be used.

   Where adjustable shelving is required but no end supports are used, provide steel brackets and standards for the adjustable shelving requirements. Steel brackets shall be deep enough to carry the full depth of the shelving. Finish for steel standards and brackets shall be anodized chrome.
5. Drawer slides shall have the following load capacities according to BHMA for dynamic rating of 75 lbs and static rating of 100 lbs. The slides shall have a self-close/stay-closed action, epoxy coated steel, nylon rollers, bottom corner mounting, captive RH profiles, tolerance compensating LH profiles, 13 mm side clearance, double warning stop with lock out position, exceeds BMHA Grade 1 requirements, and 20 mm extension drawer runners.

2.9 FABRICATION

A. Fabricate to AWI Custom standards.

B. Shop assemble work for delivery to site, permitting passage through building openings.

C. Fit exposed sheet material edges with plastic edging. Use one piece for full length only.

D. Cap exposed plastic laminate finish edges with material of same finish and pattern.

E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 600 mm from sink cut-outs.

G. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

2.10 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

A. Install work in accordance with AWI Custom Quality Standard.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of .8 mm. Do not use additional overlay trim to conceal larger gaps.

D. Install components with screws at 300 mm on center.

E. Install hardware in accordance with manufacturer's instructions.

3.3 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Brush apply one coat of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.

C. Allow preservative to dry prior to erecting members.

3.4 ERECTION TOLERANCES

A. Maximum Variation from True Position: 1.5 mm.

B. Maximum Offset from True Alignment with Abutting Materials: .8 mm.

END OF SECTION

SECTION 06650

SOLID POLYMER FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI A136.1	1967 Organic Adhesives for Installation of Ceramic Tile
ANSI Z124	1980 Plumbing

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D256	1984 Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D570	1981 Test Method for Water Absorption of Plastics
ASTM D638	1984 Test Method for Tensile Properties of Plastics
ASTM D696	1979 Test Method for Coefficient of Linear Thermal Expansion of Plastics
ASTM D1499	1984 Recommended Practice for Operating Light-and-Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics
ASTM E84	1984a Test Method for Surface Burning Characteristics of Building Materials

FEDERAL SPECIFICATIONS (FS)

FS WW-P-541E/GEN	August 1, 1980, Plumbing Fixtures (Lavatories)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD3	1980 High Pressure Decorative Laminates

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300, SUBMITTAL DESCRIPTIONS:

Data

Solid Polymer Material

Manufacturer's descriptive data, fabrication and installation instructions, warranty provisions, fabricator/installer bonding certificate.

Drawings

Solid Polymer Material

Shop Drawings shall indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.

Test Reports

Solid Polymer Material

Test Reports shall indicate compliance with specified test methods and performance levels. Safety related test data (flame spread, smoke generation, and smoke toxicity) shall be specific to the color/pattern of the material selected, i.e. solid color or granite pattern color.

Color Selection Samples

Solid Polymer Material

Samples, minimum 2 inch by 2 inch, shall indicate full range of color and pattern variation.

Operation and Maintenance Manuals

Solid Polymer Material; OIC.

Maintenance Manuals shall be submitted indicating manufacturer's care and maintenance data, including repair and cleaning instructions. Provide maintenance kit for matte finishes.

1.3 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Materials shall be stored indoors and handled to prevent damage. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

PART 2 PRODUCTS

2.1 SOLID POLYMER FABRICATION

2.1.1 Solid Polymer Components

Cast, filled polymer, not coated, laminated or of composite construction, meeting ANSI Z124 and FS WW-P-541E/GEN, having minimum physical and performance properties specified. Superficial damage to a depth of 25 mm repairable by sanding or polishing. Thickness and color as specified

on drawings.

2.1.2 Fabricated Vanity Tops

Fabricated vanity tops shall be pre-assembled from solid polymer sinks and counter tops. 36 cast-iron bowls of color almond shall be set-in seam bevel to countertop material of burnt amber color and 1/2 inch thickness. Endsplashes shall be attached with silicone sealant.

2.1.3 Edge Treatment

Edge treatment for tops shall be as indicated on drawings.

2.1.4 Performance Characteristics

PROPERTY (min or max)	REQUIREMENT	TEST PROCEDURE
Tensile Strength	5000 psi min.	ASTM D638
Flexural Strength	7000 psi min.	ASTM D790
Flexural Modulus	1.0 x 106 min.	ASTM D790
Elongation	0.3% min.	ASTM D638
Hardness scale min.	90-Rockwell "M"	ASTM D758
52-Barcol Impressor min.	ASTM D2583	
Thermal Expansion in/in/deg C. max.	3.5 x 10-6	ASTM D696
Color Stability 100 hours min.	No change,	NEMA LD3
Wear and Cleanability	Passes	ANSI Z124.3
Abrasion Resistance (1000cycles)=0.9 g.	No loss of pattern Max Weightloss	NEMA LD3-3.01 ANSI Z124.3
Impact Resistance .24ft-lbs/in min.	Notched Izod Method A	ASTM D256,
Gardner 4.5 ft-lbs min.	ASTM D3029	
Ball drop		NEMA LD3-303
1/4" sheet ball, no failure	36" min, 1/2 lb	
1/2" sheet ball, no failure	100" min, 1/2 lb	
3/4" sheet ball, no failure	150" min, 1/2 lb	

PROPERTY (min or max)	REQUIREMENT	TEST PROCEDURE
Bowls (point impact)	No cracks or chips	ANSI Z124.3 and ANSI Z124.6
Stain Resistance	Passes	ANSI Z124.3
Weatherability min.1000 hours	No change,	ASTM D1499
Fungi and Bacteria	No Attack	ASTM G21, ASTM G22
Specific Gravity	1.6 min.	

Maximum Water Absorption Weight (% max.)	24 hrs.	Long Term	
	0.05	0.50 (1/4")	ASTM D570
	0.10	0.90 (3/4")	

Flammability Solid Colors			ASTM E84
	1/4"	1/2"	3/4"
Flame spread	25 max	25 max	25 max
Smoke Developed	30 max	30 max	30 max
Class	1	1	1

Granite Pattern Colors			
	1/4"	1/2"	3/4"
Flame spread	25 max	25 max	25 max
Smoke Developed	30 max	30 max	30 max
Class	1	1	1

Pittsburgh Protocol Toxicity (as used by NY State) rating	solid-80 grams minimum rating granite patterns- 65 grams minimum	"LC50" Test

2.2 ACCESSORY PRODUCTS

2.2.1 Joint Adhesive

Joint adhesive shall be two-part adhesive kit to create inconspicuous, non-porous joints by chemical bond.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting ANSI A136.1, Underwriter's Laboratories (UL) listed)

2.2.3 Sealant

Sealant shall be mildew-resistant, FDA and UL listed silicone sealant in colors matching components.

2.2.4 Conductive Tape

Conductive tape shall be manufacturer's standard foil tape, 4 mils thick, applied around the edges of cutouts containing hot or cold appliances.

2.2.5 Insulating Felt Tape

Insulating felt tape shall be manufacturer's standard product for use with conductive tape to insulate solid polymer surfaces from hot/cold appliances.

2.3 FABRICATION

Components shall be factory fabricated to the greatest extent practical to sizes and shapes indicated on approved Shop Drawings. Joints shall be formed between components using manufacturer's standard joint adhesive. Joints shall be reinforced with 2 inch wide strips of solid polymer material. Factory cutouts shall be provided for plumbing fittings and accessories as indicated on the Drawings. Component edges shall be cut and finished with clean, sharp returns. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work shall be rejected. Inlay work shall be performed in accordance with manufacturer's product data, using acrylic or methacrylate inlay material and color indicated on the Drawings.

2.3.1 Gloss

Finished surfaces shall receive a uniform matte finish with a gloss range of 5-20/

2.3.2 Thermoforming

Thermoforming shall comply with manufacturer's product data. Molds shall be constructed of plywood in "male/female" sections matching component shapes. Component parts shall be shaped prior to joining and finishing. Pieces shall be cut to finished dimensions with edges sanded and nicks and scratches removed. Heat the entire component uniformly between 275-325 degrees Fahrenheit during forming. Prevent blistering, whitening and cracking of solid polymer material during forming. Defective material shall be rejected.

2.3.3 Sidesplashes

Coved sidesplashes shall be shop fabricated with 12.7 mm radius cove at intersection of counters and sidesplashes.

2.3.4 Counter Tops With Under Counter Mounted Lavatories

Counter tops with oval vitreous china under counter lavatories shall be 20 mm thick polymer material, having edge details as indicated on the Drawings, complete with 7 lavatory bowls. Lav bowls are provided in Section 15400, "Plumbing Systems". Template and mounting kit provided by

lavatory manufacturer attached with manufacturer sealant. Counter tops and splashes color as indicated on drawings.

PART 3 EXECUTION

3.1 JOB MOCK-UP

Prior to final approval of Shop Drawings, erect at project site one full size mock-up of each component for review. Should mock-up not be approved, re-fabricate and reinstall until approval is secured. Remove rejected units from project site. Approved mock-ups may remain as part of finished work.

3.2 INSTALLATION

Installer is to be a certified installer by component supplier and trained in installation and handling of solid polymer fabrications. Install components plumb, level and rigid in accordance with approved Shop Drawings and product data. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Adhere sinks and lavatories to tops using manufacturer's recommended adhesive and mounting hardware. Provide backsplashes and endsplashes as indicated on the Drawings. Adhere to tops using manufacturer's adhesive. Clean all assembled components before requesting acceptance. After acceptance, protect against damage during completion of the remaining project items. Components damaged by other trades after acceptance will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made.

Make plumbing connections to sinks in accordance with Division 15, Mechanical.

-- End of Section --

SECTION 07160

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cold applied asphalt bitumen damproofing.

1.2 RELATED SECTIONS

A. Section 04200 - Masonry.

B. Section 07212 - Board Insulation: Perimeter and cavity wall construction.

1.3 REFERENCES

A. ASTM D41 - Asphalt Primer Used in Roofing, Dampproofing and Waterproofing.

B. ASTM D449 - Asphalt Used in Dampproofing and Waterproofing.

C. ASTM D491 - Asphalt Mastic Used in Waterproofing.

D. NRCA (National Roofing Contractors Association) - Waterproofing Manual.

1.4 SUBMITTALS

A. Product Data: Provide properties of primer, bitumen, and mastics.

B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Waterproofing Manual.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum ten (10) years documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until membrane has cured.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Chem Rex, Inc./Sonneborne Bldg Products Div.: Product Hydrocide 128 Spray Mastic.

B. Karnak Chemical Corporation: Product 220 AF

C. Meadows W. R. Meadows, Inc.: Product Solvent-Type, Semi-Mastic.

2.2 COLD ASPHALTIC MATERIALS

A. Asphalt Mastic: ASTM D491.

B. Asphalt Primer: ASTM D41, compatible with substrate.

C. Asphalt Cement: ASTM D2822 Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate surfaces are durable, free of matter

detrimental to adhesion or application of dampproofing system.

B. Verify items which penetrate surfaces to receive dampproofing are securely installed.

3.2 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer or applicator.

D. Apply mastic to seal penetrations, small cracks, or minor honeycomb in substrate.

3.3 APPLICATION

A. Prime surfaces in accordance with manufacturer's instructions.

B. Apply cold bitumen with roller spray application by trowel.

C. Apply bitumen in two coats, continuous and uniform, at a rate of one gal/10 sm per coat.

D. Seal items projecting through dampproofing surface with mastic. Seal watertight.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 07191

VAPOR RETARDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheet and sealant materials for controlling vapor diffusion.

1.2 RELATED SECTIONS

A. Section 07213 - Batt Insulation: Insulation.

B. Section 07900 - Joint Sealers: Sealants.

1.3 REFERENCES

A. ASTM C920 - Elastomeric Joint Sealants.

B. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

C. SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 DEFINITION

A. Vapor Retarder: A material or assembly of materials that resists water vapor diffusion through it.

1.5 SYSTEM DESCRIPTION

A. Materials and installation methods to provide continuity of vapor retarder:
   1. In conjunction with materials described in Section 07213.
   2. To seal gaps between enclosure components and opening frames.

1.6 PERFORMANCE REQUIREMENTS

Modular Design System

A. Maximum Vapor Permeability (Perm): 1 ng/S/m/pa measured in accordance with ASTM E96 Method E.

1.7 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide data indicating material characteristics, performance criteria, limitations, and installation methods.

C. Manufacturer's Installation Instructions: Indicate preparation and installation requirements, techniques.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with SWRI - Sealant and Caulking Guide Specification requirements for materials and installation.

B. Maintain one copy of each document on site.

1.9 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this section.

1.10 SEQUENCING

A. Sequence Work to permit installation of materials in conjunction with other retardant materials and seals.

B. Do not install vapor retarder until items penetrating it are in place.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Sheet Retarder Type 1 opaque or translucent laminated reinforced membrane film for above grade application, having a maximum perm rating of 1.0; manufactured by the following:

Modular Design System

1. Aquabar "B" (30/30/30) for wall construction and Pyro Kure 600 for roof decks, both are products of fortifiber Corporation, 4489 Bandini Blvd., Los Angeles, CA 90023.
2. T-65 for wall construction are products of Griffolyn - Reef Industries, Inc., P. O. Box 750250, Houston, TX 77275-0250, Phone (800) 231-6074.
3. Rufco 300 for walls, a product of Raven Industries, P. O. Box 5107, Sioux Falls, SD 57117-5107, Phone (800) 635-3456.

2.2 SEALANTS

A. Polyurethane Sealant Type S: ASTM C920, Grade NS, Class 25, Use NT; single component, chemical curing, non-sagging; Buff color; Dymeric manufactured by Tremco:
   1. Elongation Capability: 25 percent.
   2. Service Temperature Range: -40 to 180 degrees F (-40 to 82 degrees C).
   3. Shore A Hardness Range:20 to 35.

B. Primer: Recommended by sealant manufacturer to suit application.

C. Cleaner: Non-corrosive type; recommended by sealant manufacturer; compatible with adjacent materials.

2.3 ADHESIVES

A. Mastic Adhesive or Tape: Non-solvent type, compatible with sheet barrier and substrate, thick mastic of uniform consistency.

2.4 ACCESSORIES

A. Thinner and Cleaner for Neoprene Sheet: As recommended by sheet material manufacturer.

B. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch (50 mm) wide, compatible with sheet material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify condition of substrate and adjacent materials.

3.2 PREPARATION

A. Remove loose or foreign matter which might impair adhesion.

B. Clean and prime substrate surfaces to receive adhesive and sealants in accordance with manufacturers' instructions.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Vapor Retarder For Stud Framed Walls: Secure sheet barrier Type 1 to stud faces with adhesive. Lap edges over stud faces, lap ends onto adjacent construction; tape ends with non-solvent adhesive to ensure complete seal.

C. Vapor Retarder Seal For Openings: Install sheet barrier Type 1 between window and door frames and adjacent vapor retarder and seal with adhesive. Position laps over firm bearing.

D. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges or where compatibility with adjacent materials may be in doubt.

END OF SECTION

SECTION 07212

BOARD INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation at cavity wall construction, perimeter foundation wall and underside of floor slabs.

1.2 RELATED SECTIONS

A. Section 04200 - Masonry.

B. Section 07213 - Batt Insulation.

C. Section 07416 - Standing Seam Metal Roof System: Rigid insulation at roof system.

1.3 REFERENCES

A. ASTM C578 - Preformed, Cellular Polystyrene Thermal Insulation.

B. ASTM C1013 - Membrane Faced Rigid Cellular Polyurethane Roof Insulation.

C. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

D. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

F. NFPA 255 - Test of Surface Burning Characteristics of Building Materials.

G. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

H. FS: Federal Specifications - HH-I-1972/1 - Insulation Board Thermal Polyurethane or Polyisocyanurate, faced with aluminum foil on both sides of the foam.

1.4 SYSTEM DESCRIPTION

A. Materials of This Section: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Section 07416.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Product Data: Provide data on product characteristics, performance criteria, and limitations.

B. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation, and installation techniques.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Sample: 100 mm x 100 mm x 25 mm thick; two pieces.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation. Follow manufacturer's instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

A. Celotex Corp. Product Thermax 610C.

B. Amoco Foam Product Amofoam - CM

C. Dow Chemical, U.S.A. Product Styrofoam High Load 115

2.2 INSULATION MATERIALS

A. PERIMETER/SLAB INSULATION
Extruded Polystyrene Insulation: ASTM C578 Type V cellular type, conforming to the following:
1. Board Density: 3.0 lb/cu ft.
2. Board Size: 400 mm x 2440 mm.
3. Board Thickness: 20 mm.
4. Thermal Resistance: R of 5.0 per 25 mm thickness.
5. Water Absorption: In accordance with ASTM D2842 0.3 percent by volume maximum.
6. Compressive Strength: Minimum 125 psi
7. Board Edges: Tongue and groove edges.
8. Flame/Smoke Properties: 5 / 165 in accordance with ASTM E84.
9. To be used as perimeter foundation wall and underside of slab on grade.

B. **CAVITY WALL INSULATION**
Polyisocyanurate Insulation: Closed cell glass fiber reinforced type, conforming to the following:
1. Board Size: 400 mm x 2440 mm.
2. Board Thickness: 50 mm.
3. Facing: Reflective aluminum foil facers.
4. Thermal Resistance: Aged (conditioned R-value as determined by ASTM C 236)R of 7.0 per 25 mm thickness at 75 degree mean temperature.
5. Board Edges: square.
6. Water Absorption: In accordance with ASTM D2842 less than 1 1/2 percent by volume maximum.
7. Flame/Smoke Properties: 20/65 in accordance with UL 723.
9. Having no HCFC's in this product.
8. To be used in the masonry cavity walls.

2.3 MANUFACTURERS - ADHESIVES

A. Amoco Foam Products

B. Celotex Corporation

C. Dow Chemical, U.S.A

2.4 ADHESIVES

A. Adhesive Type 1: Type recommended by insulation manufacturer for application.

2.5 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 50 mm.

B. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be mechanically fastened to surface to receive board insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place; as recommended by the manufacturer of the insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation.

B. Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede adhesive bond.

3.2 INSTALLATION - FOUNDATION PERIMETER

A. Adhere a 300 mm wide strip of polyethylene sheet over construction joints with double beads of recommended adhesive each side of joint.
   1. Tape seal joints.
   2. Extend sheet full height of joint.

B. Apply Type adhesive in three continuous beads per board length to full bed 3 mm.

C. Install boards on foundation wall perimeter, horizontally.
   1. Place boards in a method to maximize contact bedding.

2. Stagger side joints.
3. Butt edges and ends tight to adjacent board and to protrusions.

D. Extend boards over control joints, unbonded to foundation 100 mm on one side of joint.

E. Cut and fit insulation tight to protrusions or interruptions to the insulation plane.

F. Immediately following application of board insulation, place protective boards over exposed insulation surfaces, apply adhesive in five continuous beads per board length.
1. Install boards horizontally from base of foundation to top of insulation.
2. Butt board joints tight; stagger from insulation joints.

3.3 INSTALLATION - CAVITY WALLS

A. Apply required adhesive in three continuous beads per board length to full bed 3 mm thick on substrate. Daub adhesive tight to protrusions and indentions to ensure continuity of vapor retarder and air seal.

B. Install boards horizontally between wall reinforcement vertically.

C. Place membrane surface against adhesive. Tape seal board joints.

D. Place boards in a method to maximize contact bedding. Stagger side joints. Butt edges and ends tight to adjacent board and protrusions.

E. Cut and fit insulation tight around protrusions or interruptions to the insulation plane.

3.4 INSTALLATION - UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tight to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing slab.

3.5 PROTECTION OF FINISHED WORK

A. Do not permit work to be damaged prior to covering insulation.

3.6 SCHEDULES

A. Perimeter Insulation: Type A, extruded polystyrene, bead adhesive application, 12 mm thick protection board.

B. Cavity Wall Insulation: Type B, polyisocyanurate insulation, secured with impaling fasteners.

END OF SECTION

SECTION 07213

BATT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Batt insulation in exterior wall construction.

1.2 RELATED SECTIONS

A. Section 05400 - Cold Formed Metal Framing: Supporting construction.

B. Section 07212 - Board Insulation.

C. Section 09260 - Gypsum Board Systems: Acoustical Insulation.

1.3 REFERENCES

A. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

B. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

C. NFPA 255 - Test of Surface Burning Characteristics of Building Materials.

D. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.4 SYSTEM DESCRIPTION

A. Materials of This Section: Provide continuity of thermal barrier at building enclosure elements and in conjunction with thermal insulating materials in Section 07212.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

Modular Design System

A. Product Data: Provide data on product characteristics, performance criteria, and limitations.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

A.	Certainteed Corporation	Product Bldg Insulation
B.	Manville	Product C.I. Unfaced
C.	Owens/Corning Fiberglas	Product Thermal Batts

2.2 MATERIALS

A. Batt Insulation:
   1. Unfaced type - ASTM C665; preformed glass fiber batt; friction fit, conforming to the following:
      a. Thermal Resistance: R of 3.14 per 25 mm thickness.
      b. Batt Size: 150 mm x 2440 mm, 90 mm x 2440 mm
      c. Facing: Unfaced.
      d. Flame/Smoke Properties: 25/50 in accordance with ASTM E84.

   2. Faced batt insulation:
      a. ASTM C665 preformed glass fiber batt; friction fit, conforming to the following:
      b. Thermal Resistance: R of 3.14 per 25 mm thickness.
      c. Batt size: 150 mm x 2440 mm.
      d. Facing: Foil - reinforced-kraft facing.
      e. Flame/Smoke: 25/50.

   3. Batt insulation for enclosed/unheated storage metal building:
      a. Location: sidewalls of the metal building.

Modular Design System

b. Type: Owens-Corning Certified Metal Building Insulation. Thickness as noted on architectural drawings.
c. Physical properties:
    a. Meets ASTM C991, Type 1.
    b. Moisture Absorption: ASTM C553
    c. Bacteria and fungus: ASTM C991
    d. Odor (Owens-Corning M-05Aa)
    e. Corrosiveness (HH-I-558B Amend.)
    f. Fire Hazard Class (UL 723) flame spread 25, smoke 50
    g. Facing: Vinyl reinforced polyester
        1. Color - white
        2. Texture - Scrim
        3. Perm rating - 0.02
        4. Light reflect. 85%
        5. Temp limit 150 degree F
    h. Total thickness required, is 150 mm.

B. Sheet Vapor Retarder: clear polyethylene film conforming to ASTM D 4397, 0.15mm thick, with a maximum permeance rating of 013 perms.

C. Tape: Bright aluminum self-adhering type, mesh reinforced, 50 mm wide.

D. Insulation Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

Modular Design System

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior walls spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.

E. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

F. Metal Framing: Place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.

END OF SECTION

SECTION 07270

FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1995a) Surface Burning Characteristics of Building Materials
ASTM E 814	(1994b) Fire Tests of Through-Penetration Fire Stops

UNDERWRITERS LABORATORIES (UL)

UL-05	(1995; Supple) Fire Resistance Directory
UL 723	(1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994) Fire Tests of Through-Penetration Firestops

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Firestopping Materials; GA.

Detail drawings including manufacturer's descriptive data, typical details, installation instructions and the fire-test data and/or report as appropriate for the fire resistance rated construction and location. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations are to receive firestopping, drawings shall indicate location and type of application.

SD-13 Certificates

Firestopping Materials; GA.

Certificates attesting that firestopping material complies with the specified requirements. The label or listing of the Underwriters Laboratories will be acceptable evidence. In lieu of the label or listing,

a written certificate may be submitted from an approved, nationally recognized testing agency equipped to perform such services, stating that the items have been tested and conform to the specified requirements and testing methods.

Installer Qualifications; FIO.

Certification stating that installer is qualified and trained to install the specified firestopping material.

Inspection; FIO.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

Installer of firestopping material shall be trained by the manufacturer or the manufacturer's representative, and shall have a minimum of 3 years experience in the installation of firestopping of the type specified.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL-05.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479, except that T Ratings are not required for penetrations smaller than or equal to a 100 mm nominal pipe or 0.01 square meter in overall cross sectional area. Fire resistance ratings shall be the following:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = 2 hour, T Rating = 2 hour.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping for filling floor voids 100 mm or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Firestopping shall be provided in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through fire-resistance rated walls and partitions.

b. Penetrations of vertical shafts such as pipe chases.

c. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

d. Construction joints in floors and fire rated walls and partitions.

e. Other locations where required to maintain fire resistance rating of the construction.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

-- End of Section --

SECTION 07416

STANDING SEAM METAL ROOF SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Precoated galvanized steel roofing and associated integral flashings.

B. Integral gutters and downspouts.

C. Integral fascias

1.2 RELATED SECTIONS

A. Section 05120 - STRUCTURAL STEEL

B. Section 05210 - STEEL JOIST

C. Section 05300 - STEEL DECKING

D. Section 07212 - BOARD INSULATION: Rigid insulation under metal roofing system.

E. Section 07900 - JOINT SEALER.

1.3 REFERENCES

A. AMERICAN IRON AND STEEL INSTITUTE (AISI)

1. AISI SG-673 (1986; Addenda 1989; Errata Nov 30, 1990) Cold-Formed Steel Design Manual

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 446 (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

2. ASTM A 463 (1988) Steel Sheet, Cold-Rolled

Aluminum-Coated, Type 1 and Type 2

3. ASTM A 792 (1989) Steel Sheet, Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

4. ASTM B 117 (1990) Salt Spray (Fog) Testing

5. ASTM B 209 (1990) Aluminum and Aluminum-Alloy Sheet and Plate

6. ASTM C 518 (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

7. ASTM D 522 (1988) Mandrel Bend Test of Attached Organic Coatings

8. ASTM D 523 (1989) Specular Gloss

9. ASTM C 665 (1991) Std. Spec for Mineral Fiber Blanket Thermal Insulation for Light Frame Const. and Manufacturing Housing

10. ASTM D 714 (1987) Evaluating Degree of Blistering of Paints

11. ASTM D 968 (1981; R 1991) Abrasion Resistance of Organic Coatings by Falling Abrasive

12. ASTM D 1308 (1987) Effect of Household Chemicals on Clear and Pigmented Organic Finishes

13. ASTM D 1654 (1979a; R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

14. ASTM D 2244 (1989) Calculation of Color Differences from Instrumentally Measured Color Coordinates

15. ASTM D 2247 (1987) Testing Water Resistance of Coatings in 100 Percent Relative Humidity

16. ASTM D 2794 (1990) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

17. ASTM D 3359 (1990) Measuring Adhesion by Tape Test

18. ASTM D 4214 (1989) Evaluating the Degree of Chalking of Exterior Paint Films

19. ASTM D 4397 (1984; R 1989) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

20. ASTM E 84 (1991a) Surface Burning Characteristics of Building Materials

21. ASTM E 96 (1992) Water Vapor Transmission of Materials

22. ASTM G 23 (1990) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

C. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

1. ASCE 7 (1988) Minimum Design Loads for Buildings & Other Structures

D. FEDERAL SPECIFICATIONS (FS)

1. FS HH-I-1972 (1981; R1991) Insulation Board, Thermal Faced, Polyurethane or Polyisocyanurate

E. METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

1. MBMA-01 (1986; Errata; Supple 1990) Low Rise

F. UNDERWRITERS LABORATORIES (UL)

1. UL 580 (1988, Rev thru Dec 1 1989) Test for Uplift Resistance of Roof Assemblies

1.4 MANUFACTURER

A. Standing seam metal roof system (SSMRS) shall be the product of a recognized SSMRS manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 3 years and has been involved in at least 5 projects similar in size and complexity to this project.

1. A representative of the SSMRS manufacturer, who is familiar with the design of the standing seam metal roof system supplied and experienced in the erection of roof systems similar in size to the one required under this contract, shall be present at the job site during installation of the SSMRS to assure that the roof system meets the specified requirements. The manufacturer's representative shall be an employee of the manufacturer with at least two years experience in installing the roof system that is certified by the SSMRS manufacturer to have two years of experience installing similar roof systems.

2. Installer: The installer shall have a minimum of 2 years experience and shall have been involved in installing at least 3 projects that are of comparable size, scope and complexity as this project for the particular roof system furnished.

1.5 DESIGN REQUIREMENTS

A. The SSMRS shall be designed by the Manufacturer as a complete system. Members and connections not indicated on the drawings shall be designed by the Manufacturer.

Modular Design System

1. Design Conditions: Loading criteria shall be in accordance with ASCE 7 unless otherwise specified. The structural section properties used in the design of the framing members shall be determined using the unloaded shape of the roof panels. Roof panels, components, transitions, and assemblies shall be the products of the same manufacturer. There shall be a minimum of two fasteners per clip; single fasteners will be allowed when the supporting structural members are prepunched or predrilled.

2. Dead Load: The design dead load shall be the actual weights of the SSMRS components as determined by the manufacturer.

3. Concentrated Loads: The panels and concealed anchor clips shall be capable of resisting a 200-pound concentrated load at midspan on a 300 mm wide section of deck. The panels shall support the combined dead load and concentrated load without buckling or permanent distortions; and the panel deflection shall not exceed 1/180th of the span between supports.

4. Live Loads: The design live loads shall be the roof snow loadings given on the drawings

5. Wind Uplift Loads: The design uplift pressures for the roof system shall be computed and applied using a basic wind speed of 49 m/s (fastest mile), an importance factor of 1.15, and an exposure Category C. The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the safety factor of 2.25 when two or more fasteners are in each connection.

6. Thermal Loads: Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total 200 degree temperature range

during the life of the structure.

7. Roof Panels: Steel panels shall be designed in accordance with AISI SG-673. The panel deflection under applied dead load plus live load and/or wind load shall not exceed 1/180 times the span between supports; deflections shall be based on panels being continuous across two or more supports, the specified fastener spacing, and the ability of the panel to rotate freely on the support.

8. Accessories and Fasteners: Accessories shall be capable of resisting the specified design wind uplift loads and shall allow for movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces.

1.6 PERFORMANCE REQUIREMENTS

A. The uplift resistance of the SSMRS shall be in strict accordance with performance testing which shows UL 580; I-90 classification approval for all system components, fastening devices, and completed assembly applied to metal deck and/or supporting structural roof framing members.

1.7 SUBMITTALS: The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

A. Design Analysis: Design analysis signed by a Registered Professional Engineer, prior to beginning of manufacture. The design analysis shall include, but not be limited to, the following wind and thermal information:

1. Wind forces on various parts of the roof. Both positive and negative pressures shall be calculated with the controlling pressure summarized.

2. Thermal movements that will result from the

specified temperature range.

B. Calculations: The calculations shall be accompanied by details from the manufacturer that demonstrate how installed concealed anchor clips and other roof system devices will accommodate the required thermal movement.

C. Shop Drawings: Standing Seam Metal Roof System submittal shall include Contractor's drawings and specifications; design and erection drawings, shop coating and finish specs; samples, guarantees; and other data as necessary to clearly describe design materials, sizes, layouts, standing seam configuration, construction details, provisions for thermal movement, line of panel fixity, fastener sizes and spacings, sealant(s) and erection procedures. Drawings shall reflect the intent of the architectural detailing using the manufacturer's Proprietary products and fabricated items as required.

D. Qualifications:
Copy of current qualifications and experience of the SSMRS installer and field representative.

E. Tests: UL 580 classification I-90 identification listing member and test report for uplift resistance of the SSMRS.

F. Certificates: Standing Seam Metal Roof System.

1. Certification that the actual thickness of uncoated steel sheets used in SSMRS components including roofing panels, subpurlins, and concealed anchor clips comply with specified requirements.

2. Certification that the sheets to be furnished are produced under a continuing quality control program have been listed and have met the quality standards specified for factory color finish.

3. Mill certification for structural bolts and roof panels.

G. Samples:

1. Accessories: One sample of each type of flashing, trim, closure, thermal spacer block, cap and similar items. Size shall be sufficient to show construction and configuration.

2. Roof Panels: One piece of each type to be used, 300 mm long, full width.

3. Fasteners: Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

4. Insulation: One piece, 300 mm by 300 mm, of each type and thickness to be used, and descriptive data.

5. Gaskets and Insulating Compounds: Two samples of each type to be used and descriptive data.

6. Sealant: One sample, approximately 1 pound, and descriptive data.

7. Concealed anchor clip: Two samples of each type used.

8. EPDM rubber boots: One piece of each type.

9. Gutter and Downspout: One piece of each type.

1.8 MOCKUP

A. Provide mockup of standing seam metal roof system; 2.4 m long by 1.22m wide, which includes associated attachments, flashings, joints and junctions, control or expansion joints, terminating item (edge condition at

roof edge.)

B. Locate where directed.

C. Mockup may not remain as part of the Work.

1.9 DELIVERY AND STORAGE

A. Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage accommodations for roof covering shall provide good air circulation and protection from surface staining.

1.10 GUARANTEE

A. The SSMRS shall be guaranteed for 20 years against leakage arising out of or caused by ordinary wear and tear by the elements. The SSMRS shall also be guaranteed for 20 years against paint finish deterioration beyond limits set forth for the factory color finish. Such guarantee shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

PART 2. PRODUCTS

2.1 MANUFACTURER AND PROFILE

A. Subject to compliance with requirements, provide products of one of the following:

1. A-E-P Span; Span-Lok SL216 Profile, 450 mm panel width.

2. Centria Roof Systems, SDP200 Profile, 450 mm panel width.

3. Merchant & Evans; Interlock Profile, 450 mm panel

width.

4. Morin Corporation; SSR16/18 Profile, 450 mm panel width.

2.2 ROOF PANELS/FASCIA PANELS

A. Roof and fascia panels are the same profile. Color for fascia panels shall match roof panels. Panels shall be steel and shall have a factory color finish. The SSMRS assembly shall be Class 90 as defined in UL 580. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope when such slope is 9150 mm or less. When length of run exceeds 9150 mm and panel splices are provided, each sheet in the run shall extend over three or more supports. Sheets longer than 9150 may be furnished if approved by the Contracting Officer. Width of sheets shall provide not more than 600 mm of coverage in place. SSMRS with roofing panels greater than 300 mm in width shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be not less than 50 mm. All sheets shall be either square-cut or miter-cut except that gable end wall sheets may be cut in the shop to correspond to the roof slope and may have a horizontal joint at the eave line.

1. Steel Panels: Zinc-coated steel conforming to ASTM A 446, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65. Panels shall be 22 ga (.85 mm) minimum.

   Roof panels for both buildings (enclosed/unheated storage building and hangar building) shall be of the same profile and from the same manufacturer for a uniform appearance. Provide structural standing seam metal panels for enclosed/unheated storage building. Provide structural standing seam metal roof panels for the hangar building if like

architectural panels are unavailable from same manufacturer.

2.3 FACTORY COLOR FINISH

A. Roof panels shall have a factory color finish on the exposed side. The exterior finish shall have a .8 mil primer coat on the front side with a .8 mil 70% Kynar 500 color coat and a .8 mil 70% Kynar 500 clear topcoat on the exterior. The exterior color shall be as selected from the manufacturer's standard colors including manufacturer's special or custom colors (Primary and Secondary Colors). The interior color finish shall consist of a backer coat with a dry film thickness of 0.5 mil. The exterior color finish shall meet the test requirement specified below. The manufacturer shall have conducted tests on previously manufactured sheets of the same type and finish as proposed for the project. The term "appearance of base metal" refers to the metal coating on the steel base metal.

1. Salt Spray Test: A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 10, no blistering, as determined by ASTM D 714; and rating of 10, no edge creep failure at scribe, as determined by ASTM D 1654.

2. Formability Test: When subjected to a 180-degree bend over a 9 mm diameter mandrel in accordance with ASTM D 522, exterior coating film shall show no evidence of fracturing to the naked eye.

3. Accelerated Weathering, Chalking Resistance and Color Change: A sample of the sheets shall withstand a weathering test a minimum of 2000 hours in accordance with ASTM G 23 using a Type D apparatus or 500 minimum hours using type EH

apparatus. No peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal shall be present. After the 2000 hour weatherometer test, exterior coating color change shall not exceed 5 color difference units in accordance with ASTM D2244 and chalking shall be less than NO. 8 rating.

4. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

5. Impact Resistance: Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 equal to 1.5 times metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

6. Abrasion Resistance Test: When subjected to the falling sand test in accordance with ASTM D 968 the coating system shall withstand a minimum of 80 liters per mil of sand before the appearance of the base metal.

7. Specular Gloss: Finished surfaces shall have a specular gloss of 25 to 35 at an angle of 60 degrees when measured in accordance with ASTM D 523. For enclosed/unheated storage building finished roof surfaces shall have a specular gloss value of 10 or less at an angle of 85 degrees.

8. Pollution Resistance: Coating shall show no visual effects when immersion tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.4 ACCESSORIES

A. Accessories shall be compatible with the covering furnished. Flashing, trim, downspouts, gutters, metal

closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for roofing panels. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering and shall not absorb or retain water. Thermal spacer blocks and other thermal barriers at concealed clip fasteners shall be as recommended by the manufacturer.

2.5 FASTENERS

A. Fasteners for steel roof panels shall be zinc-coated steel, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear strength of not less than 3.34 kN (750 pounds) per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 10 mm for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 3.2 mm thick.

1. Screws: Screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

2. Bolts: Bolts shall be not less than 6 mm diameter, shouldered or plain shank as required, with locking washers and nuts.

3. Structural Blind Fasteners: Blind screw-type expandable fasteners shall be not less than 6 mm diameter. Blind (pop) rivets shall be 7 mm minimum diameter.

2.6 INSULATION

A. Thermal resistance of insulation shall be not less than the R-values shown. R-values shall be an established aged value at 5 years, determined at 75 degrees F in accordance with ASTM C 518. Insulation shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 75 when tested in accordance with ASTM E 84; shall be a standard product of a manufacturer, factory-marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Insulation shall have a facing providing a permeability of 1.0 perm or less when tested in accordance with ASTM E 96. Facing shall be 1.0 mil thick aluminum foil laminate. Reinforced foil with a natural finish may be used for facing in concealed locations. Facings and finishes shall be factory applied. Insulation shall contain the highest practicable percentage of recovered material which has been diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided.

1. Rigid or Semi-rigid Board Insulation: Rigid board insulation shall be closed cell polyisocyanurate faced on both sides with aluminum foil conforming to FS HH-I-1972 and FS HH-I-1972/1, Class 2. The R-value is to be 30, maximum of 100 mm thick.

2.7 CONCEALED ANCHOR CLIPS

A. Concealed anchor clips shall have factory punched or drilled holes for attachment. Clips used with panel width greater than 300 mm shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip.

2.8 SEALANT

Modular Design System

A. Except as stated below, sealants shall be elastomeric type containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. All sealants shall be the nonhardening type. Roof panel standing seam ribs shall have a continuous sealant that is factory installed.

2.9 GASKETS AND INSULATING COMPOUNDS

A. Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.10 EPDM RUBBER BOOTS

A. Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from weather-resistant EPDM rubber. Rubber boot material shall be as recommended by the manufacturer. The boots shall have base rings made of corrosion resisting steel that conform to the contours of the roof panel to form a weather-tight seal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the approved erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated from each other by means of gaskets or insulating compounds. Molded closure strips shall be installed wherever covering sheets terminate in open-end configurations, exclusive of flashings. The closure strip installation shall be weather-tight and sealed. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces

and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

1. Roof Panel Installation: Roof panels shall be installed with the standing seams in the direction of the roof slope. The side seam connections for installed panels shall be completed at the end of each day's work. Method of applying joint sealant shall conform to the manufacturer's recommendation as needed to achieve a complete weather-tight installation. End laps, when approved by the Contracting Officer, shall be made over framing members. Closures, flashings, EPDM rubber boots and related accessories shall be installed according to the drawings. Fasteners shall not puncture covering sheets except as approved for flashing, closures, and trim. Exposed fasteners shall be installed in straight lines and shall be permitted only at the rakes, eaves, panel splices, and where required for the attachment of flashings, gutter and other similar accessories. Expansion joints shall be installed at locations indicated on the drawings.

2. Concealed Anchor Clips: Roof panels shall be fastened to framing members with concealed fastening clips or other concealed devices. Clips shall be attached to the deck or to the subpurlins with bolts or screws. The maximum distance between clips, and the spacing and type of fasteners shall conform with UL580 Class I-90 performance requirements for the specific system to be installed on the project. In no case shall that distance be greater than 1520 mm on center.

3.2 INSULATION INSTALLATION

A. Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

Modular Design System

1. Board Insulation: Joints shall be tight and sealed or taped as required by the manufacturer.

3.3 NOT USED

3.4 NOT USED

3.5 CLEANING AND TOUCH-UP

A. Exposed SSMRS shall be cleaned at completion of installation. Debris that could cause discoloration and harm to the panels, flashings, closures and other accessories shall be removed. Grease and oil films, excess sealants, and handling marks shall be removed and the work shall be scrubbed clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Factory color finished surfaces shall be touched up as necessary with the manufacturer's recommended touch up paint.

END OF SECTION

SECTION 07465

PREFORMED METAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preformed prefinished metal wall panel system for walls (interior and exterior), liners, related flashings and accessory components.

B. Building paper back-up over sheathed walls.

1.2 RELATED SECTIONS

A. Section 05120: Structural Steel: Structural steel building frame.

B. Section 05400 - Cold Formed Metal Framing: Stud wall framing system.

C. Section 09260 - Gypsum Board System: Building paper back-up.

D. Section 07213 - Batt Insulation.

E. Section 08520 - Aluminum Windows.

F. Section 13120 - Standard Metal Building Systems.

1.3 REFERENCES

A. ASTM A167 - Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet, and Strip.

B. ASTM A446/A446M - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

C. ASTM A525/A525M - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.

D. ASTM A606 - Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy, with Improved Corrosion Resistance.

E. ASTM A755/A755M - Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil Coating Process For Exterior Exposed Building Products.

F. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction.

1.4 SYSTEM DESCRIPTION

A. System: Preformed and prefinished metal siding system of vertical profile; site assembled; with steel stud framing, steel girt framing or metal furring assembly.

1.5 DESIGN REQUIREMENTS

A. Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with local code.

B. Maximum Allowable Deflection of Panel: 1/180 of span.

C. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.

D. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

E. Products: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Section 07213.

1.6 SUBMITTALS:

Modular Design System

A. Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage and vertical lines of siding alignment with the standing seams of the roof panels.

B. Samples: Submit two samples of all types of siding used, 304.8 x 610 mm in size illustrating finish color, sheen, and texture. Provide sample of preformed metal siding and attachment devices.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum six years documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Transport, handle, store, and protect products.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Store prefinished material off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

D. Prevent contact with materials which may cause discoloration or staining.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Centria Architectural Systems
1005 Beaver Grade Road
Moon Township, PA 15108-2944

Modular Design System

(412) 299-8000

1. Exterior/Interior Wall Panels for Hangar Door - IW-10A, 300 mm panel width, non-embossed, flush face.

2. Interior Wall Panels for Draft Curtain - IW-10A, 300 mm panel width, non-embossed, flush face.

3. Interior Wall Liner Panels - L21A liner panel, 300 mm or 600 mm panel width. Match color for interior panels at draft curtain and hangar doors.

4. Exterior Wall Panels - Hangar Building - TR4-36, 915 mm panel width.

B. Morin Corporation
685 Middle Street
Bristol, Connecticut 06010
860-584-0900

1. Exterior/Interior Wall Panels for Hangar Door - F-12, 300 mm panel width, flush face.

2. Interior Wall Panels for Draft Curtain - F-12, 300 mm panel width, flush face.

3. Interior Wall Liner Panels - L-24-5F, 300 or 600 mm panel width. Match color for interior panels at draft curtain and hangar doors.

4. Exterior Wall Panels - Hangar Building - Y-36, 915 mm panel width.

C. BHP Steel Building Products USA Inc.
Sacramento, CA
800-726-2727

1. Exterior/Interior Wall Panels for Hangar Door - Prestige (R-O) -12, 300 mm panel width, smooth surface, flush face.

2. Interior Wall Panels for Draft Curtain - Prestige (R-O) -12, 300 mm panel width, smooth surface, flush face.

3. Interior Wall Liner Panels - Prestige (R-O) -12, 300 mm panel width, smooth surface, flush face. Match color for interior panels at draft curtain and hangar doors.

4. Exterior Wall Panels - Hangar Building - HR-36, 915 mm panel width.

2.2 EXTERIOR SHEET MATERIALS

A. Precoated Galvanized Steel Panels: Hot-dipped, zinc-coated steel sheet conforming to ASTM A 653, G90 coating designation conforming to ASTM A525, Grade A minimum. Panels shall be 22 Ga. (.85 mm) minimum. Panels shall have a factory color finish on the exposed side. Galvanized panels shall have a 0.8 mil primer coat on the front side with 0.8 mil 70% Kynar 500 color coat and a 0.8 mil 70% Kynar 500 clear topcoat on the exterior. The exterior color shall be as selected form the manufacturers standard colors including from the manufacturers special or custom colors. (Primary and Secondary Colors). The interior color finish shall consist of a backer coat with a dry film thickness of 0.5 mil.

2.3 INSULATION

A. Insulation: Glass fiber batts specified in Section 07213; thermal resistance R of 19 (RSI of 3.34).

2.4 ACCESSORIES

A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant; color as selected.

B. Sealants: Manufacturer's standard type suitable for use with installation of system; non-staining, skinning, non-shrinking and non-sagging; ultra-violet and ozone resistant; color as selected.

C. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, stainless steel; fastener cap same color as exterior panel. Exposed fasteners same finish as panel system.

D. Field Touch-up Paint: As recommended by panel manufacturer.

E. Building Paper: ASTM D226, 73 kg/sq m unperforated asphalt felt. Bituminous coating of cold applied asphalt mastic, SSPC Paint 12, 15 mils.

F. Closure Strips: Closed cell, self-extinguishing expanded cellular rubber foam.

2.5 COMPONENTS

A. Exterior Sheet: Minimum 1.2 mm thick precoated steel stock profile as indicated; panel width as indicated; interlocking edges, fitted with continuous gaskets filled with sealant.

B. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles. Mitered internal corners to be back braced with 1.2 mm thick precoated sheet stock to maintain continuity of profile.

C. Trim, Closure Pieces, Caps, Flashings, and Facias Infills: Manufacturers standard of same material, thickness and finish as exterior sheets; brake formed to required profiles.

D. Anchors: Galvanized steel.

2.6 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest practicable lengths.

C. Panel Profile: Refer to Paragraph 2.1 of this specification. Provide flush vented soffit panels at soffits above sliding hangar door.

D. Fabricate corners in one continuous piece with minimum 150 mm returns.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that framing members are ready to receive panel system.

3.2 NOT USED

3.3 INSTALLATION

A. Install metal wall panel system on substrate in accordance with manufacturer's instructions.

B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.

C. Fasten wall panels to structural supports; aligned, level, and plumb.

D. Locate joints over supports. Lap panel ends minimum 50 mm.

E. Provide expansion joints where indicated.

F. Use concealed fasteners unless otherwise approved by Contracting Officer.

G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.4 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1.6 mm.

B. Maximum Variation from Plane or Location Indicated on Drawings: 6 mm.

3.5 CLEANING

A. Remove site cuttings from finish surfaces.

B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sill, and lintel, flashings.

B. Gutters and downspouts.

C. Counterflashings at vent stacks.

D. Spring type Flashing System, a manufactured product.

1.2 NOT USED

1.3 RELATED SECTIONS

A. Section 06114 - Wood Blocking and Curbing: Wood blocking for metal roofing substrate profiles.

B. Section 07900 - Joint Sealers.

1.4 REFERENCES

A. ASTM D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

B. ASTM D4586 - Asphalt Roof Cement, Asbestos-Free.

C. NRCA (National Roofing Contractors Association) - Roofing Manual.

D. SMACNA - Architectural Sheet Metal Manual.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations,

and installation details.

B. Samples: Submit two samples, 200 mm x 200 mm in size illustrating typical seam, external corner, internal corner, junction to vertical dissimilar surface, material and finish and metal finish color.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA/NRCA standard details and requirements.

1.7 QUALIFICATIONS

A. Fabricator and Installer: Company specializing in sheet metal flashing work with six years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, weathertight, ventilated areas until immediately before installation.

B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials which may cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Copper Sheet: ASTM B 370.

B. Steel Sheet, zinc coated (galvanized) factory finished ASTM A 525M.

2.2 ACCESSORIES

A. Fasteners: Same material and finish as the sheet metal, with soft neoprene washers.

B. Primer: Zinc chromate.

C. Protective Backing Paint: Zinc chromate alkyd.

D. Sealant: Polyurethane type, specified in Section 07900.

E. Bedding Compound: Rubber-asphalt.

F. Plastic Cement: ASTM D4586, Type I.

G. Gutter and Downspout Anchorage Devices: SMACNA requirements. Type recommended by fabricator. Finish: Match roof panels.

H. Gutter Supports: Brackets, Straps, Spikes and ferrules. Finish of gutter support - same as gutter and downspours.

I. Downspout Supports: Brackets Straps. Finish same as downspouts.

J. Sprinklok Flashing System shall be Type "MA" as manufactured by Fry Reglet Corporation, 625 So. Palm Avenue, Alhambra, CA 91803. Reglet and flashing shall be made of steel of .025 thick with a gray epoxy finish. Other acceptable manufacturers:
   1) Cheney Flashing Co.
      P. O. Box 818
      Trenton, N.J. 08605
      Phone: (800) 322-2873

2.3 COMPONENTS

A. Gutters: Rectangular SMACNA style profile.

B. Downspouts: Rectangular profile.

C. Accessories: Profiled to suit gutters and downspouts.

D. Downspout Boots: Cast iron.

2.4 FABRICATION

Modular Design System

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate cleats of same material as sheet, minimum 12 mm thick and continuous in width, interlockable with sheet.

C. Form pieces in longest possible lengths.

D. Hem exposed edges on underside 12 mm; miter and seam corners.

E. Form material with standing seams.

F. Fabricate corners from one piece with minimum 450 mm long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 6 mm and hemmed to form drip.

H. Fabricate flashings to allow toe to extend 2 inches over roofing material. Return and brake edges.

2.5 FINISH

A. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

3.3 INSTALLATION

A. Conform to drawing details.

B. Secure flashings in place using concealed fasteners.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Seal metal joints watertight.

F. Secure gutters and downspouts in place using concealed fasteners.

G. Slope gutters 6 mm per foot minimum.

H. Connect downspouts to downspout boots storm sewer system. Grout and connection watertight.

I. Seal metal joints watertight.

J. Use 50/50 solder and neutralize flux after soldering lead.

3.4 FIELD QUALITY CONTROL

A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 07900

JOINT SEALERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparing substrate surfaces.

B. Sealant and joint backing.

1.2 RELATED SECTIONS

A. Section 07160 - Bituminous Dampproofing: Sealants required in conjunction with dampproofing.

B. Section 07417 - Standing Seam Metal Roof System: Sealants required in conjunction with metal roofing.

C. Section 07620 - Sheet Metal Flashing and Trim: Sealants required in conjunction with metal flashings.

D. Section 08520 - Aluminum Windows: Sealants required in conjunction with aluminum windows.

E. Section 08800 - Glazing: Sealants required in conjunction with glazing methods.

1.3 REFERENCES

A. ASTM C790 - Use of Latex Sealing Compounds.

B. ASTM C804 - Use of Solvent-Release Type Sealants.

C. ASTM C834 - Latex Sealing Compounds.

D. ASTM C919 - Use of Sealants in Acoustical Applications.

E. ASTM C920 - Elastomeric Joint Sealants.

F. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

G. ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).

H. SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

B. Samples: Submit two samples, 50 mm x 50 mm in size illustrating sealant colors for selection.

C. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform acoustical sealant application work in accordance with ASTM C919.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum five years documented experience approved by manufacturer.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8 WARRANTY

A. Provide a five year warranty.

B. Warranty: Include coverage for installed sealants and accessories which fail to achieve air tight seal, water tight seal, and exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 SEALANTS

A. Acrylic Emulsion Latex for interior use only (Type C): ASTM C834, single component; white color; manufactured by one of the following: Pecora Corp - "AC-20"; Sonolac" - Sonneborn Building Prod. Div., Chem Rex, Inc., "Temco Acrylic Latex 834" - Tremco.

B. Polyurethane Sealant (Type S): ASTM C920, Grade NS, Class 25, Use M,G,A; single component, chemical curing, non-staining, non-bleeding, non-sagging type; Mameco, Pecora Corp., Peterson, Harry S. PRC, Sika Corp., color as selected; manufactured by Tremco.
   1. Elongation Capability 25 percent
   2. Service Temperature Range -40 to 180 degrees F
   3. Shore A Hardness Range 20 to 35

C. Silicone Sealant (Type S): ASTM C920, Grade NS, Class 25, Use NT,M,G,A single component, chemical curing, non-sagging, non-staining, non-bleeding; Dow Corning; GE, Mobay Corp., color as selected; manufactured by Pecora Corp.
   1. Elongation Capability 50 percent
   2. Service Temperature Range -35 to 160 degrees F
   3. Shore A Hardness Range 30

D. Fire stopping sealant type. Firestopping is required at through fire wall penetrations, rated fire wall abutments to structure and deck and through horizontal rated assembly construction.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

Modular Design System

C. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces and joint openings are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Remove loose materials and foreign matter which might impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with ASTM C804 for solvent release and ASTM C790 for latex base sealants.

3.3 INSTALLATION

A. Perform installation in accordance with ASTM C804 for solvent release and ASTM C790 for latex base sealants.

B. Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.

C. Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints concave.

3.4 CLEANING

A. Clean adjacent soiled surfaces.

3.5 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

END OF SECTION

SECTION 08111

STANDARD STEEL DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-rated and fire rated steel doors.

1.2 RELATED SECTIONS

A. Section 08112 - Standard Steel Frames.

B. Section 08211 - Flush Wood Doors.

C. Section 08712 - Door Hardware.

D. Section 08800 - Glazing: Glass for doors.

E. Section 09900 - Painting: Field painting of doors.

1.3 REFERENCES

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. ANSI/SDI-100 - Standard Steel Doors and Frames.

C. ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

D. ASTM E152 - Methods of Fire Tests of Door Assemblies.

E. Door Hardware Institute (DHI) - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

F. NFPA 80 - Fire Doors and Windows.

G. NFPA 252 - Fire Tests for Door Assemblies.

H. UL 10B - Fire Tests of Door Assemblies.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing, louvers, and finish.

B. Product Data: Indicate door configurations, location of cut-outs for hardware reinforcement.

C. Manufacturer's Installation Instructions: Indicate special installation instructions.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Conform to requirements of ANSI/SDI-100 and ANSI A117.1.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum four years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Fire Rated Door Construction: Conform to ASTM E152.

B. Fire Rated Door Construction: Rate of rise of 250 F degrees across door thickness.

C. Installed Door Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Doors shall be stored in an upright position. Whenever damage becomes evident, abraded, scarred, or rusty areas shall be cleaned and touched up with the paint used for the shop painting.

B. Protect doors with resilient packaging sealed with heat shrunk plastic.

C. Break seal on-site to permit ventilation.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 DOOR MANUFACTURERS

A. Fenestra Corporation

B. Republic Builders Products

C. Steelcraft Manufacturing Company

2.2 DOORS

Grade II - Heavy-duty 44 mm (Level B): Interior Doors
Model 3 - Seamless - Hollow Steel Construction

Grade III - Extra heavy-duty 44 mm (Level A): Exterior Doors
Model 4 - Seamless - Composite Construction

A. Exterior Doors (Thermally Broken): SDI-100 Grade III Model 4. Minimum gauge for face metal sheet shall be 14 gauge.

B. Interior Doors (Non-rated): SDI-100 Grade II Model 3. Face metal for interior doors shall be 18 gauge.

C. Interior Doors (Fire Rated): SDI-100 Grade II Model 3. Face metal for interior fire-rated doors shall be 18 gauge.

2.3 DOOR CONSTRUCTION

A. Face: Steel sheet in accordance with ANSI/SDI-100.

B. Core: Cardboard honeycomb steel channel grid vertical steel stiffeners.

2.4 ACCESSORIES

A. Removable Stops: Rolled steel shape, butted corners; prepared for countersink style tamper proof screws.

B. Primer: Zinc chromate type.

2.5 FABRICATION

A. Astragals for Double Doors: Steel, Z shaped, specifically for double doors.

B. Fabricate doors with hardware reinforcement welded in place.

C. Attach fire rated label to each door unit.

D. Close top and bottom edge of exterior doors with inverted steel channel closure. Seal joints watertight.

E. Configure exterior doors with special profile to receive recessed weatherstripping.

2.6 FINISH

A. Steel Sheet: Galvanized to ASTM A525 G60.

B. Primer: Air dried.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install doors in accordance with ANSI/SDI-100 and DHI.

B. Coordinate installation of glass and glazing.

C. Coordinate installation of doors with installation of frames specified in Section 08112 and hardware specified in Section 08710.

3.3 ERECTION TOLERANCES

A. Maximum Diagonal Distortion: 1.5 mm measured with straight

edge, corner to corner.

3.4 ADJUSTING

A. Adjust door for smooth and balanced door movement.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 08112

STANDARD STEEL FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-rated, fire rated steel frames.

B. Interior glazed light frames.

1.2 RELATED SECTIONS

A. Section 08111 - Standard Steel Doors.

B. Section 08211 - Wood Doors.

C. Section 08712 - Door Hardware.

D. Section 08800 - Glazing.

E. Section 09900 - Painting: Field painting of frames.

1.3 REFERENCES

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. ANSI/SDI-100 - Standard Steel Doors and Frames.

C. ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

D. ASTM E152 - Methods of Fire Tests of Door Assemblies.

E. DHI - Door Hardware Institute: The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

F. NFPA 80 - Fire Doors and Windows.

G. NFPA 252 - Fire Tests for Door Assemblies.

H. UL 10B - Fire Tests of Door Assemblies.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate frame elevations, reinforcement, and finish.

B. Product Data: Indicate frame configuration, anchor types and spacings, location of cut-outs for hardware, reinforcement.

C. Samples: Submit two carrier samples of frame, 300 mm x 300 mm size illustrating construction of frame and surface texture.

D. Manufacturer's Installation Instructions: Indicate special installation instructions.

E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Conform to requirements of ANSI/SDI-100 and ANSI A117.1.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum four years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Fire Rated Frame Construction: Conform to ASTM E152.

B. Installed Frame Assembly: Conform to NFPA 80 for fire rated class same as fire door.

1.8 DELIVERY, STORAGE, AND HANDLING

A. To provide protection during shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or provided with temporary steel spreaders at the bottom of each frame. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting good air circulation. Assembled frames shall be stored in an upright position. Whenever damage becomes evident, abraded, scarred, or rusty areas shall be cleaned and touched up with the paint used for the shop painting.

B. Accept frames on site in manufacturer's packaging. Inspect for damage.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 FRAME MANUFACTURERS

A. Fenestra Corporation

B. Republic Builders Products

C. Steelcraft Manufacturing Company

2.2 FRAMES

A. Exterior Frames: 14 gage thick material, base metal thickness.

B. Interior Frames: 16 gage thick material, base metal thickness.

2.3 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole.

B. Removable Stops: Rolled steel channel shape, butted corners; prepared for countersink style tamper proof screws.

C. Bituminous Coating: Fibered asphalt emulsion.

D. Primer: Zinc chromate type.

2.4 FABRICATION

A. Fabricate frames as welded unit.

B. Mullions for Double Doors: Fixed type, of same profiles as jambs.

C. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.

D. Reinforce frames wider than 1220 mm with roll formed steel channels fitted tightly into frame head, flush with top.

E. Prepare frame for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.

F. Configure exterior frames with special profile to receive recessed weatherstripping.

G. Fabricate frames to suit masonry wall coursing with 100 mm head member.

2.5 FINISH

A. Steel Sheet: Galvanized to ASTM A525 G60.

B. Primer: Air dried.

C. Coat inside of frame profile with bituminous coating to a thickness of 1.5 mm.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install frames in accordance with ANSI/SDI-100 and DHI.

B. Coordinate with masonry and wallboard wall construction for anchor placement.

C. Coordinate installation of glass and glazing.

D. Coordinate installation of frames with installation of hardware specified in Section 08710 and doors in Section 08111.

E. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

3.3 ERECTION TOLERANCES

A. Maximum Diagonal Distortion: 1.5 mm measured with straight edges, crossed corner to corner.

END OF SECTION

SECTION 08211

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid flush wood doors; flush configuration.

1.2 RELATED SECTIONS

A. Section 08112 - Standard Steel Frames: Steel door frames.

B. Section 08712 - Door Hardware.

C. Section 08800 - Glazing.

D. Section 09900 - Painting: Site finishing doors.

1.3 REFERENCES

A. ANSI A135.4 - Basic Hardboard.

B. ASTM E90 - Measurement of Airborne Sound Transmission Loss of Building Partitions.

C. ASTM E413 - Classification for Determination of Sound Transmission Class.

D. AWI - Quality Standards of the Architectural Woodwork Institute.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, special blocking for hardware, identify cutouts for glazing and louvers.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics; factory machining criteria.

C. Samples:

1. Submit two samples of door construction, 304.8 x 304.8 mm in size cut from top corner of door.

D. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with AWI Quality Standard Section 1300, Premium Grade.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of General Requirements.

B. Package, deliver and store doors in accordance with AWI Section 1300.

1.8 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

A. Coordinate work under provisions of General Requirements.

B. Coordinate the work with door opening construction, door frame and door hardware installation.

1.10 WARRANTY

A. Provide the following warranty to the following terms:
1. Life of Installation: Interior doors.

B. Include coverage for delamination of veneer, warping

beyond specified installation tolerances, defective materials, telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Algoma/Hardwoods, Algoma, WI, Ph 800-678-8910: Product - Architectural Wood Flush Door

B. Eggers Industries, Two Rivers, WI ph 414-793-1351: Product Architectural Wood Flush Door

C. Weyerhaeuser Architectural Door Div., Marshfield, WI ph 800-869-3667: Product - Architectural Wood Flush Door

2.2 DOOR TYPES

A. Flush Interior Doors: 44 mm thick; solid core construction, acoustic rated as indicated.

2.3 DOOR CONSTRUCTION

A. Core Solid, Non-Rated: AWI Section 1300, Type PC5-Particleboard.

B. Core (Solid, Special Function): AWI Section 1300, Type SR - Sound Retardant (Acoustical)

2.4 FLUSH DOOR FACING

A. Veneer Facing (Flush Interior Doors): AWI Premium quality species wood, rotary cut, birch for stain finish.

2.5 ADHESIVE

A. Facing Adhesive: Type II - water resistant.

2.6 NOT USED

2.7 FABRICATION

A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.

B. Sound Rating For Single Door Leaf and Frame Assembly: ASTM E413, minimum STC 35.

C. Provide lock blocks at lock edge and top of door for closer for hardware reinforcement.

D. Vertical Exposed Edge of Stiles: Of same species as veneer facing for stain finish.

E. Fit door edge trim to edge of stiles after applying veneer facing.

F. Bond edge banding to cores.

G. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Provide solid blocking for through bolted hardware.

H. Factory pre-fit doors for frame opening dimensions identified on shop drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes and tolerances are acceptable.

B. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install non-rated doors in accordance with AWI Quality Standards requirements.

B. Trim non-rated door width by cutting equally on both jamb edges.

C. Trim door height by cutting bottom edges to a maximum of 19 mm.

D. Pilot drill screw and bolt holes. Use threaded through bolts for half surface hinges.

E. Machine cut for hardware. Core for handsets and cylinders.

F. Coordinate installation of doors with installation of frames specified in Section 08112 and hardware specified in Section 08710.

3.3 INSTALLATION TOLERANCES

A. Conform to AWI requirements for fit and clearance tolerances.

B. Conform to AWI Section 1300 requirements for maximum, vertical, width, and diagonal distortion.

3.4 ADJUSTING

A. Adjust door for smooth and balanced door movement.

END OF SECTION

SECTION 08318

SECURITY VAULT DOOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vault Doors: The vault door unit shall be a steel security-vault type door with frame, day gate, and ramp type threshold, and shall be a standard product of a manufacturer specializing in this type of fabrication.

B. Day Gate

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete

1.3 REFERENCES

A. Federal Specifications (FS):
1. FS AA-D-600: Rev B; Int Am 6 Door, Vault, Security.

1.4 SUBMITTAL

A. Submit under provisions of Section 01300.

B. Government approval is required. Manufacturer's catalog data including catalog cuts and brochures. The data shall show that the proposed vault door unit conforms with the requirements of the Federal Specifications, and has been tested and approved by the General Services Administration (GSA).

C. Certification shall state that vault-door units that do not bear the GSA label are constructed to Class 5 standards.

D. Shop Drawings: Submit shop drawing for the fabrication and installation of all items furnished under this section. Drawings shall be submitted for approval prior to

fabrication.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle security vault in manner to prevent damage and deterioration.

B. Follow special storage and handling requirements of manufacturer.

C. Protect exposed finish surfaces of prefinished items.

PART 2 PRODUCTS

2.1 VAULT DOOR AND FRAME

A. Design and construction of the door and frame assembly shall conform to FS AA-D-600. The door shall be Class 5, Type swing as indicated on the drawings without optical device, Style K - key change combination lock.

2.2 DAY GATE

A. The day gate shall be the manufacturer's standard product designed for use with the vault door furnished, and shall provide access control and visual security. The gate shall be hinged on the same side as the vault door, shall swing into the vault, and shall have a locking device operable from outside by key and from inside by knob or handle.

PART 3 EXECUTION

3.1 INSTALLATION

A. The vault door assembly shall be installed in strict compliance with the printed instructions and drawings provided by the manufacturer. The day gate shall be installed in a manner that will not interfere with operation of the release handle on the inside of the vault door. After installation, the door, the locking mechanism, and the inner escape device shall be adjusted for proper operation.

END OF SECTION

SECTION 08331

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Overhead coiling door, operating hardware, electric operation.

B. Wiring from electric circuit disconnect to door operator to control station.

1.2 RELATED SECTIONS

A. Section 05500 - Metal Fabrications: Support framing.

B. Section 08710 - Door Hardware: Cylinder core and keys.

C. Section 09900 - Painting: Field paint finish.

D. Section 16111 - Conduit: Conduit from electric circuit to door operator and from door operator to control station.

E. Section 16111 - Conduit: Conduit from fire alarm control to fusible link activator.

F. Section 16180 - Equipment Wiring Systems: Power to disconnect.

1.3 REFERENCES

A. ASTM A480/A480M - Flat Rolled Stainless Heat Resisting Steel Plate, Sheet, and Strip.

B. ASTM A525/A525M - Steel Sheet, Zinc-coated (Galvanized) by the Hot-Dip Process.

C. ASTM A526/A526M - Steel Sheet, Zinc-coated (Galvanized) by the Hot-dip Process, Commercial Quality.

Modular Design System

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

F. NEMA MG1 - Motors and Generators.

G. UL - Fire Resistance Directory.

1.4 SYSTEM DESCRIPTION

A. Electric motor operated unit with manual override in case of power failure.

B. Coiling Door: Surface mounted.

1.5 DESIGN REQUIREMENTS

A. Design door assembly to withstand wind/suction load of 20 psf, without undue deflection or damage to door or assembly components.

B. Insulation Value: R of 6.25.

1.6 SUBMITTALS: Section 01300 - Procedures for submittals.

A. Product Data: Provide general construction, component connections, details, and electrical equipment.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

C. Samples: Submit two door slats, 150 mm x 300 mm in size illustrating shape, color and finish texture.

D. Manufacturer's Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

1.7 DATA PROVIDED AT CLOSEOUT

Modular Design System

A. Operation and Maintenance Data; Warranties and Bonds.

B. Maintenance Data: Indicate lubrication requirements and frequency, periodic adjustments required.

1.8 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

Modular Design System

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Atlas Roll-Lite Overhead Doors, Div. of MASCO.
   2. The Cookson Company
   3. Overhead Door Corp.

2.2 MATERIALS

A. Curtain: conforming to the following:
   1. Slats:
      a. Insulated slats shall be furnished for all exterior overhead coiling doors. Slats shall be interlocking, minimum 24 gage (.607 mm thick) of ASTM A526 steel, galvanized to minimum 1.25 oz/sq ft (380 g/sq m) coating in accordance with ASTM A525; sandwich slat construction with insulated core of polyurethane type insulation.
      b. Non-insulated slats shall be furnished for all interior overhead coiling doors. Slats shall be interlocking, minimum 22 gauge (0.759 mm thick) of ASTM A526 steel, galvanized to minimum 1.25 oz/sq. ft. (380 g/sq m) coating in accordance with ASTM A525; single thickness slat.
   2. Nominal Slat Size: 75 mm wide x required length.
   3. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   4. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact with floor in closed position.
   5. Vision Lites: Furnish clear acrylic plastic sections over individual slats cutouts, each 125 mm wide x 20 mm high, in sets of 3 cutouts, one slat high, three cutouts wide. Vision lite slat to be standard F-3 non-insulated flat slat.

B. Guides: 5 mm thick; 75 mm wide; galvanized steel conforming to ASTM A526, galvanized to minimum 1.25 oz/sq ft (380 g/sq

m) coating in accordance with ASTM A525 of continuous angles, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.

D. Hood Enclosure: 24 gage galvanized steel; internally reinforced to maintain rigidity and shape.

E. Hardware: Manufacturer's standard lock mechanism with cylinders keyed to Owner's master keying system.

2.3 ELECTRIC OPERATOR

A. Electric Operator:
1. Description: UL 325, side mounted.
2. Motor Enclosure: NEMA MG1 Type 1; open drip proof.
3. Motor Rating: 3/4 hp (560 W); continuous duty.
4. Motor Voltage: 208-230 volt, three phase, 60 Hz.
5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter with Class 10; bimetal; manual rent; overload relay (one per phase).
6. Controller Enclosure: NEMA 250 Type 1.
7. Door Speed: 300 mm/s
8. Brake: Adjustable friction clutch type, activated by motor controller.

B. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary control for each operator; 24 volt circuit; surface mounted. Provide one controller for each side of door. Provide weatherproof enclosure for exterior controllers.

C. Safety Edge: Located at door bottom, full width, electro-mechanical sensitized type, wired to stop, reverse door upon striking object, hollow neoprene covered weather seal.

2.4 FINISHES

A. Curtain Slats: Steel, galvanized.

B. Steel Guides and Hood Enclosure: Prime paint.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 16180. Complete wiring from disconnect to unit components and from fire alarm system to door operator.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.

G. Install perimeter trim and closures.

3.3 ERECTION TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent

work.

B. Maximum Variation From Plumb: 1.5 mm.

C. Maximum Variation From Level: 1.5 mm.

D. Longitudinal or Diagonal Warp: Plus or minus 3 mm per 3 m straight edge.

3.4 ADJUSTING

A. Adjust door, hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean door and components.

B. Remove labels and visible markings.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 08332

OVERHEAD COUNTER SHUTTER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Overhead shutter, operating hardware, manual operation.

1.2 RELATED SECTIONS

A. Section 05500 - Metal Fabrications: Support framing.

B. Section 08710 - Door Hardware: Cylinder core and keys.

1.3 REFERENCES

A. ASTM A480/A480M - Flat Rolled Stainless Heat Resisting Steel Plate, Sheet, and Strip.

B. ASTM B221/A221M - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

1.4 SYSTEM DESCRIPTION

A. Electrically operated unit with overhead counter balance device.

B. Coiling Shutter: Surface mounted.

1.5 SUBMITTALS: Section 01300 - Submittal Procedures: Procedures for submittals.

A. Product Data: Provide general construction, component connections and details.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

Modular Design System

C. Samples: Submit two shutter slats, 100 x 10 mm in size illustrating shape, color and finish texture.

D. Manufacturer's Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

1.6 DATA PROVIDED AT CLOSEOUT

A. Operation and Maintenance Data; Warranties and Bonds.

B. Maintenance Data: Indicate lubrication requirements and frequency, periodic adjustments required.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Atlas Roll-Lite Overhead Doors, Div. of MASCO
2. The Cookson Company
3. Overhead Door Corp.

2.2 MATERIALS

A. Curtain: conforming to the following:
1. Insulated slats: Interlocking, fire-rated to rating indicated for wall installed, minimum 22 gauge (0.759 mm thick) of ASTM A526 steel, prefinished.
2. Nominal Slat Size: 75 mm wide x required length.
3. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
4. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact with sill in closed position.

B. Guides: 5 mm thick; 75 mm wide; prefinished steel continuous angles, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

C. Roller Shaft Counterbalance: Steel pipe and helical steel

spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.

D. Hood Enclosure: 24 gage prefinished steel; internally reinforced to maintain rigidity and shape.

E. Hardware: Manufacturer's standard locking mechanism with cylinder keyed to Owner's master keying system.

2.3 ELECTRIC OPERATOR

A. Electric Operator:
1. Description: UL 325, side mounted.
2. Motor Enclosure: NEMA MG1 Type 1 open drip proof.
3. Motor Rating: 3/4 hp (560 W); continuous duty.
4. Motor Voltage: 208 - 230 volt, three phase, 60 Hz.
5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
6. Controller Enclosure: NEMA 250 Type 1.
7. Door Speed: 300 mm/s
8. Brake: Adjustable friction clutch type, activated by motor controller.

B. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary control for each operator; 24 volt circuit; surface mounted.

C. Safety Edge: Located at door bottom, full width, electro-mechanical sensitized type, wired to stop, reverse door upon striking object, hollow neoprene covered weather seal.

2.4 FINISHES

A. Curtain Slats: Prefinished steel. Color as selected from manufacturer's standard colors.

B. Steel Guides and Hood Enclosure: Prefinished.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01039 - Coordination and Meetings: Verification of existing conditions before starting work.

B. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 16180. Complete wiring from disconnect to unit components and from fire alarm system to door operator.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.

G. Install perimeter trim and closures.

3.3 ERECTION TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1.5 mm.

C. Maximum Variation From Level: 1.5 mm.

D. Longitudinal or Diagonal Warp: Plus or minus 3 mm per 3 m straight edge.

3.4 ADJUSTING

A. Adjust door, hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean door and components.

B. Remove labels and visible markings.

END OF SECTION

SECTION 08342

STEEL SLIDING HANGAR DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673	(1989; Errata 1990) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1994) Carbon Structural Steel
ASTM A 366/A 366M	(1991; R 1993) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 569/A 569M	(1991; Rev. A, R 1993) Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 653/A 653M	(1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 920	(1994) Elastomeric Joint Sealants
ASTM E 84	(1995; Rev. A) Surface Burning Characteristics of Building Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 6	(1991) Commercial Blast Cleaning
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

UNDERWRITERS LABORATORIES INC. (UL)

UL 506	(1994; R 1994, Bul. 1994 and 1995) Specialty Transformers

1.2 DESIGN REQUIREMENTS

1.2.1 Door Design

The hangar doors shall be designed by the manufacturer in accordance with the criteria specified. Doors shall operate without binding, interference, or damage to weatherstripping. Doors shall fit closely and be free from warping.

1.2.2 Steel Design

AISC S335, AISI SG-673.

1.2.3 Loading

Design doors as a system to withstand an external wind load of 2.0 kilopascal acting externally or internally, the deflection shall not exceed the height of the door divided by 240. The deflection due to design wind load shall not exceed length divided by 120 for any door member. Fiber stresses due to combined dead load and wind load shall not exceed the recommended design stresses for the material used and type of loading sustained.

1.2.4 Connections

Design connections at top and bottom guide rails to withstand an external and an internal wind load of not less than 2.4 kPa, whichever is greater, and a seismic load equal to 0.5 times the weight of the door.

1.2.5 Cold-Formed Steel Members

Cold-formed steel main members and girts shall be not less than 6 mm thick.

1.3 SUBMITTALS

Submit the following in accordance with section 01300 "Submittal Procedures."

1.3.1 Drawings

a. Hangar doors

1.3.1.1 Hangar Door Electrical Drawings

Submit the door manufacturer's complete schematic wiring diagram, field

wiring diagram, and a complete physical location drawing showing the location of controls with the runs of conduit, size of conduit, number and size of wires in each conduit, location of junction boxes, and full details of control mountings.

1.3.1.2 Hangar Door Drawings

Submit drawings showing details of construction, installation, and operation; size, shapes, and thickness of materials; joints and connections; reinforcing; hardware; mechanical devices; electrical devices; and design and detail data for work of other trades affected by hangar doors.

1.3.2 Design Data

a. Hangar doors

Submit design drawings and structural, mechanical, and "U" value calculations.

1.3.3 Operation and Maintenance Manuals

a. Hangar doors

Submit Operation and Maintenance Manuals with wiring and control diagrams.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

The hangar door manufacturer shall be one who is regularly engaged in the production of steel sliding hangar doors of type and size required for this project.

1.4.2 Installer's Qualifications

The installation supervisor shall be an authorized representative of the door manufacturer. Mechanics shall be skilled and experienced in the erection of hangar doors of type and size required for this project.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials which are not shop installed on the doors in original rolls, packages, containers, boxes, or crates bearing the manufacturer's name, brand, and model number. Store materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling. Handle doors carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

PART 2 PRODUCTS

2.1 HANGAR DOORS

2.1.1 Structural Steel

AISC S335 and ASTM A 36/A 36M.

2.1.2 Formed Steel

AISI SG-673.

2.1.3 Sheet Steel

ASTM A 569/A 569M hot-rolled steel sheet, commercial quality, or ASTM A 366/A 366M cold-rolled steel sheet, commercial quality.

2.1.4 Galvanized Steel

ASTM A 653/A 653M, coating designation G 90 galvanized steel sheet, commercial quality.

2.1.5 Exterior Covering

Preformed metal siding as specified in Section 07465, "Preformed Metal Siding."

2.1.6 Interior Covering

Preformed metal siding is specified in Section 07465, "Preformed Metal Siding."

2.1.7 Insulation

Provide insulation that:

a. Contains no asbestos;

b. Is permanently secured in place behind the exterior covering; and

c. Has a flame spread rating of 75 or less and a smoke-developed rating of 100 or less when tested in accordance with ASTM E 84.

Do not use cellular plastics as exposed finish material. The doors shall have an air-to-air "U" value of not more than R-5 per 25 mm thickness.

2.1.8 Hardware

Provide hangar door hardware to accommodate actual dead loads plus wind loads specified. Provide top guide rollers, bottom wheels, interleaf bumpers, tractor pulls, track cleaners, and top bumpers as required for a complete and operational installation.

2.1.8.1 Wheel Assemblies

Bottom wheels shall be of steel plate or cast steel, having a minimum tread diameter as required for the actual wheel loading. Construct wheel assemblies to permit removal of the wheel without removing the door leaf from its position on the rail.

a. Treads: Machine wheel treads concentric with bearing seats. The clear distance between flanges shall not exceed the width of the rail by more than 3 mm at the tread nor more than 6 mm at the edge of the flange. Machine internal bearing seats accurately for a press fit. Heat treat wheels 450 mm or greater in diameter to obtain a rim hardness of 320 Brinnel.

b. Wheel bearings: Provide tapered roller or spherical bearings,

either internal or cartridge type, arranged so that both horizontal and vertical loads shall be transferred to the rail only through the bearing. Bearings shall be tightly sealed and equipped with high-pressure grease fittings.

2.1.8.2 Fixed Pancake Top Guide Rollers

Horizontal type; each with single or double steel rollers of a suitable diameter and thickness for satisfactory performance under the designated load conditions and top guide system used. Provide permanently lubricated bearings. Rollers shall be stainless steel.

2.1.8.3 Vertical Floating Head Top Guide Rollers

Provide top-roller assemblies to:

a. Move up and down within the specified live load positive and negative deflection of the roof in the vicinity of the door opening;

b. Allow easy removal through the top of the guide system; and

c. Include both horizontal and vertical rollers built into a frame which is connected in such a manner as to transmit the specified wind loads from the door to the hangar structure and to prevent disengagement of the door from the top guide.

Rollers shall be stainless steel.

2.1.9 Personnel Doors

The hangar door manufacturer shall provide structural frames and electrical interlock for personnel doors.

2.1.9.1 Doors and Frames

Specified in Section 08111, "Standard Steel Doors." and Section 08112 "Standard Steel Frames."

2.1.9.2 Hardware for Personnel Doors

Specified in Section 08710, "Door Hardware."

2.1.9.3 Electrical Interlock

Provide each personnel door with an electrical interlock switch to prevent motor operation of the leaf or group in which it is located when the personnel door is open. Provide an identified indicator light at each door leaf control station indicating when the personnel door is in the open position.

2.1.10 Weather Stripping

Provide adjustable and readily replaceable material. Provide on vertical edges, sills, and heads to afford a weathertight installation.

2.1.10.1 Neoprene

Use flap-type, two-ply, cloth-inserted neoprene or extruded, double flap, single or dual opposed solid neoprene material on vertical edges and sills.

The two-ply material shall have a minimum thickness of 3 mm and shall be retained continuously for its full length and secured with rust-resistant fasteners 300 mm o.c. Extruded weather stripping with heavy center section shall be attached at 300 mm o.c., but continuous bar may be omitted. Clearance between metal parts on vertical edges of leaves and between leaves and jambs which are to be weather-stripped shall be as indicated.

2.1.10.2 Metallic

Form head weather stripping material between each leaf and the top guide system of not lighter than 1.2 mm thick galvanized sheet steel or flap-type, cloth-inserted neoprene, as indicated.

2.1.11 Fasteners

Either zinc-coated or cadmium-plated steel.

2.1.12 Sealant

Single-component or multicomponent elastomeric type conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Provide a sealant that has been tested on the types of substrate to which it will be applied.

2.1.13 Primer

Red iron oxide, zinc oxide type, SSPC Paint 25.

2.1.14 Starters

Provide magnetic reversing starters in NEMA ICS 1, Type 12 enclosures equipped with access door-controlled, fused safety disconnect switches. Starters shall be factory wired with overload and undervoltage protection, mechanical and electrical interlocks, auxiliary contacts, relays and timing devices as required, control circuit transformers, and a numbered terminal strip. The control circuit transformer shall reduce the voltage in the control circuits to 115 volts or less, and shall conform to UL 506.

2.1.15 Electrical

Provide conduit, wire, flexible cables, boxes, devices, and accessories and install trolley duct. If permanent electrical power is not available when door installation is complete, provide temporary power for testing and adjusting the doors.

2.2 FABRICATION

2.2.1 Doors

2.2.1.1 Frames and Framing

Door leaves shall be of welded or bolted construction. Joints shall develop 100 percent of the strength of the framing members. Vertical members shall be continuous throughout the height of the door. When required, prepare splices to facilitate field assembly in accordance with standard practice. Frames and framing members shall be true to dimensions and square in all directions; no leaf shall be bowed, warped, or out of line in the vertical or horizontal plane of the door opening by more than one mm in 2 meters. Provide diagonal bracing so that the completed leaf assembly will be braced to withstand shipping, assembly, and operational

loads. Exposed welds and welds which interfere with the installation of various parts such as cover sheets shall be ground smooth.

2.2.2 Locking Devices

Do not provide locking devices on motor-operated hangar doors.

2.2.3 Tractor Pulls

Provide tractor pulls so that leaves can be towed by a tractor or similar equipment in the event of power failure.

2.2.4 Track Cleaners

Provide a device to clear debris from the rail head and wheel flange grooves as the leaf is moved.

2.2.5 Insulation

Secure insulation to doors with clips, studs, or adhesive. Protect insulation within 2400 mm of floor with steel liner sheets secured to framing 300 mm o.c. at edges with zinc-coated, self-tapping screws.

2.3 OPERATION

2.3.1 Hangar Door Types

Hangar doors shall be biparting as indicated.

2.3.1.1 Individually Operated Doors

Each door leaf shall have a separate, traction-drive operating unit driving one or more of the bottom wheels. Each leaf shall have a motor-mounted, spring-set, solenoid-released motor brake. Each leaf shall move independently of the other leaves. Provide doors that require operating personnel to walk with the leaf as it moves.

2.3.2 Operating Units

Each operating unit shall move its leaf at a speed of approximately 20 meters per minute at zero wind load conditions and to be operable up to and including a maximum wind load of 0.8 kilopascals. The operating units shall consist of either a separate motor and gear reducer or a gearhead motor, high-speed shaft brake, and necessary roller chains and sprockets. The systems shall be provided with overload protection for the drive units and a means for emergency tractor towing operation.

a. Motors shall be single speed, squirrel-cage type of sufficient size to operate the leaves under zero wind load conditions at not more than 75 percent of their rated capacity.

b. Gear reduction units shall allow a reversal of effort through the gears without damage to the units.

c. Operating mechanisms shall be covered on the interior of the leaf by a hinged 1.5 mm thick flat steel cover.

2.3.3 Braking Systems

Braking systems shall be designed to ensure stoppage of the leaves under normal, dry rail conditions within the safety edge overtravel limit. The braking systems shall be either a magnetic, spring-set, solenoid-released brake or hydraulic type. Provide a hand release to release the brake when it becomes necessary to move the leaf with an outside force. The hand release shall be an automatic reset type so that the brake will be operable during subsequent electrical operation of the door.

2.3.4 Controls

Doors shall be controlled by constant pressure push buttons mounted on the door leaves. Removing pressure from the button shall stop the movement of the leaves. The control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. Interior push buttons shall be mushroom head type, mounted in heavy-duty, oil-tight enclosures conforming to NEMA ICS 6, Type 13, except that enclosure for reversing starter with disconnect switch shall be Type 1 or Type 12. Exterior push buttons shall be in watertight enclosures conforming to NEMA ICS 6, Type 4.

2.3.4.1 Push Buttons for Individually Operated Doors

The leaves mounted on the outer rails shall have the push buttons mounted on the exterior face; the leaves on the inner rails shall have the buttons mounted on the interior face; and the leaves on the middle rails shall have the buttons mounted on both the exterior and interior faces. The button at each edge of a leaf shall allow the leaf to travel with that edge as the leading edge only. The controls shall not be reversible. Location of each control button shall be as indicated.

2.3.5 Limit Switches

Provide limit switches to prevent overtravel and bumping. Safety edges shall not be used as limit switches.

2.3.5.1 Plunger-Type Limit Switches

Provide at each edge of each leaf of individually operated doors. Limit switches shall be actuated by 20 mm diameter stainless steel rods of adjustable length, guided at both ends with nonmetallic bearings and with tape-type constant force springs to return the rods to their normal position after actuation. The actuating rods shall have sufficient overtravel so that the leaves cannot bump one another or any portion of the building or be damaged when being towed. Each rod shall be adjustable 150 mm plus or minus from its normal position.

2.3.6 Safety Edges

Provide fail-safe safety edges on each edge of each leaf of individually operated doors from 25 mm above the floor to the top of the door leaf. For leaves 300 mm thick or less, provide a single run of safety edge. For leaves over 300 mm thick, provide a double run of safety edge spaced to provide the maximum degree of safety in stopping the leaves.

a. Design: Provide safety edges to provide a minimum of 90 mm of overtravel after actuation until solid resistance is met. Safety edges shall be electric.

b. Operation: Actuation of the safety edge on leading edge of a group of leaves shall stop movement of the group. Actuation of a safety

edge shall lock out the motor control in the direction of travel until reset, but shall permit the door to be reversed away from the obstruction which tripped the safety edge. Safety edges shall be alive only when doors are moving. Safety edges shall be reset by moving doors away from the obstruction. The lower portion of the safety edges to a height of approximately 1500 mmshall be independently removable for convenience in servicing or repair. The remainder of the edge may be in one piece up to a maximum of 6000 mm.

2.3.6.1 Electrical Safety Edges

Connect the safety edge in series with the necessary relays and resistors to make the system complete. The service shall be not more than 24 volts and the circuit shall be normally energized so that the malfunction of any of the component parts will make the door inoperative.

2.3.7 Warning Device

Provide a clearly audible signal on each individually operated leaf. The warning device shall:

a. Operate when the push button is actuated for movement of the door in either direction;

b. Sound 5 seconds before the door moves, and while the door is moving; and

c. Consist of not less than a 150 mm diameter bell or equivalent decibel-rated horn, loud enough to be heard in the hangar and on the apron.

2.3.8 Emergency Operation

Hangar doors shall be constructed and equipped so that they can be operated-manually or by tractors from the hangar floor in case of power failure. Manual operation of hangar doors shall be designed to avoid damage to safety edges.

2.3.9 Electrical Work

The door manufacturer shall provide the proper electrical equipment and controls built in accordance with the latest NEMA standards. Equipment, control circuits, and safety edge circuits shall conform to NFPA 70. Where located 450 mm or less above the floor, they shall be explosion-proof as defined in NFPA 70, Article 513. Manual or automatic control devices necessary for motor operation of the doors shall be provided, including push button stations, limit switches, combination fused disconnect switches and magnetic reversing starters, control circuit transformers, relays, timing devices, warning devices, and trolley ducts with collectors or trolleys.

2.3.9.1 Trolley Ducts

Provide one or more runs of trolley duct as required for the door system provided. Ducts shall have solid copper conductors in a protective steel housing. Locate ducts as shown on door manufacturer's drawings. Provide adequate clearances in the top guide system for the ducts.

a. Each run shall consist of the required number of sections of

straight track, a section of dropout track, feed boxes, end caps, couplings, hangers, and other accessories to make the system complete and workable.

b. Furnish one track-supported tandem trolley or self-supporting collector for each individually motor-operated door, complete with spring-loaded brush contacts. Provide trolley pulling brackets and corrosion-protected chains attached from each side of the pulling bracket to each side of the tandem trolley or support bracket for self-supporting collectors.

2.3.9.2 Electrical Cables

Flexible cables or cable reels shall be provided under Section 16123, "Building Wire and Cable," in accordance with the door manufacturer's approved drawings and wiring diagrams.

PART 3 EXECUTION

3.1 PROTECTIVE COATINGS

3.1.1 Cleaning

After fabrication, clean metal surfaces in accordance with SSPC SP 6 (Commercial Blast).

3.1.2 Shop Painting

After cleaning, coat steel surfaces other than machine-finished parts with priming paint. Keep paint off of finished bearing surfaces. Before assembly, prime surfaces that will be inaccessible after assembly. Handle painted materials with care to avoid scraping or breaking the protective film. Make match-marks on painted surfaces only.

3.2 ERECTION

Assemble doors and accessories in accordance with approved shop drawings. Do not erect doors until the work of other trades in preparing the opening has been completed, the hangar roof is under full dead load, and the top guide and rail systems are within specified tolerances. After completing erection and before starting field painting, clean interior and exterior door surfaces. Clean abraded surfaces, field welds, and field bolts; and coat with priming paint.

3.3 FIELD QUALITY CONTROL

3.3.1 Manufacturer's Field Services

Provide an authorized representative of the door manufacturer to supervise erection of doors.

3.3.2 Tests

Immediately after the door installation is complete, the door manufacturer or his representative shall perform a complete operating test in the presence of the Contracting Officer. Correct defects disclosed by the test. Retest the doors and adjust them until the entire installation is fully operational and acceptable to the Contracting Officer.

-- End of Section --

SAFETY PAYS

Modular Design System

SECTION 08410

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum doors and frames.

B. Vision glass infill panels.

C. Door hardware.

D. Perimeter sealant.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 05500 - Metal Fabrication: Placement of structural supporting anchors.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 08712 - Door Hardware: Hardware items other than specified in this section.

1.4 RELATED SECTIONS

A. Section 05500 - Metal Fabrications: Metal fabricated attachment devices and framed openings.

B. Section 07900 - Sealants: System perimeter sealant and back-up materials.

C. Section 08520 - Aluminum Windows: Operable sash within glazing system.

D. Section 08800 - Glazing.

1.5 REFERENCES

Modular Design System

A. AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. AAMA - Curtain Wall Manual #10 - Care and Handling of Architectural Aluminum From Shop to Site.

C. AAMA 603.8 - Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum.

D. AAMA 605.2 - Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

E. AAMA 606.1 - Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.

F. AAMA 607.1 - Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.

G. AAMA 608.1 - Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

H. AAMA SFM-1 - Aluminum Storefront and Entrance Manual.

I. ANSI A117.1 - Safety Standards for the Handicapped.

J. ANSI/ASTM A36 - Structural Steel.

K. ANSI/ASTM A386 - Zinc Coating (Hot Dip) on Assembled Steel Products.

L. ANSI/ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

M. ANSI/ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

N. ANSI/ASTM E283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.

O. ANSI/ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure

Difference.

P. ANSI/ASTM E331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

Q. SSPC - Steel Structures Painting Council.

1.6 SYSTEM DESCRIPTION

A. Aluminum entrances and storefront system includes tubular aluminum sections, shop fabricated, factory pre-finished, vision glass, infill, related flashings, anchorage and attachment devices.

1.7 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with local code and as measured in accordance with ANSI/ASTM E330.

B. Limit mullion deflection to flexure limit of glass with full recovery of glazing materials.

C. System to accommodate, without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.

D. Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with AAMA 501.

E. Vapor Seal with Interior Atmospheric Pressure of 25 mm sp, 22 degrees C, 40 Percent RH: No failure.

F. Maintain continuous air and vapor barrier throughout assembly, primarily in line with inside pane of glass and

heel bead of glazing compound.

G. System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees over a 12 hour period without causing detrimental affect to system components.

H. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.8 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details and manufacturer's standard color chart for the High Performance Organic coating.

C. Samples: Submit two samples of each color 100 mm x 100 mm in size illustrating pre-finished aluminum surface, glass units, glazing materials.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.9 QUALITY ASSURANCE

A. Perform Work in accordance with AAMA SFM-1 and AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. Conform to requirements of ANSI A117.1.

1.10 QUALIFICATIONS

A. Manufacturer and Installer: Company specializing in

manufacturing aluminum glazing systems with minimum six years documented experience.

1.11 NOT USED

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum entrance and storefront components in the manufacturer's original protective packaging.

B. Store aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.

C. Protect pre-finished aluminum surfaces with wrapping stripable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.13 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealants when ambient temperature is less than 40 degrees during and 48 hours after installation.

1.14 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.15 WARRANTY

A. Provide three year warranty.

B. Warranty: Include coverage for complete system for failure to meet specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers offering equivalent Products.

Modular Design System

1. Kawneer Company, Inc.
2. United States Aluminum Corp.
3. Vistawall Architectural Products

2.2 MATERIALS

A. Extruded Aluminum: ANSI/ASTM B221; 6063 alloy, T5 temper.

B. Sheet Aluminum: ANSI/ASTM B209 alloy, temper.

C. Steel Sections: ANSI/ASTM A36; shaped to suit mullion sections.

D. Fasteners: Stainless steel.

E. Shop and Touch-Up Primer for Steel Components: SSPC 15, Type 1, red oxide.

2.3 COMPONENTS

A. Frame: 50 x 115 mm nominal dimension; thermally broken with interior tubular section insulated from exterior; flush glazing stops; drainage holes; internal weep drainage system. Frames for interior glazing need not to be thermally broken.

B. Doors: 44 mm thick, 89 mm wide top rail, 89 mm wide vertical stiles, 165 mm wide bottom rail; square glazing stops.

C. Flashings: 3 mm thick aluminum finish as selected to match mullion sections where exposed.

2.4 GLASS AND GLAZING MATERIALS

2.5 SEALANT MATERIALS

2.6 HARDWARE

A. Weather Stripping: Wool pile, continuous and replaceable.

B. Sill Sweep Strips: Retracting resilient seal type, of

neoprene compound.

C. Threshold: Extruded aluminum, one piece per door opening, ribbed non-slip surface.

D. Hinges: Swing clear butt type.

E. Push/Pull: staple 25 mm O.D. dia. style.

F. Panic Device: Refer to Section 08710 - Door Hardware.

G. Closer: Manufacturer's standard for storefront line provided.

H. Security Lock Deadlatch: Per manufacturer's standard.

I. Cylinder Lock Thumb Turn: Refer to Section 08710 - Door Hardware.

2.7 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to conceal from view.

E. Prepare components with internal reinforcement for door hardware and door operator hinge hardware.

2.8 FINISHES

A. Exterior Exposed Aluminum finish coatings to conform to AAMA 605.2 except doors to have the same exterior finish coating on all exposed aluminum surfaces.

B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq ft Primed with iron oxide paint.

C. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings.

G. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

H. Set thresholds in bed of mastic and secure.

I. Install hardware using templates provided.

J. Install glass in accordance with Section 08800, to glazing method required to achieve performance criteria.

K. Install perimeter sealant to method required to achieve performance criteria Type S, backing materials, and installation criteria in accordance with Section 07900.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 1.5 mm every 1 meter non-cumulative.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 0.8 mm.

3.4 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.5 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished Work from damage.

END OF SECTION

SECTION 08520

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Extruded aluminum windows with fixed and operating sash; glass shop glazed.

B. Operating hardware and insect screens.

1.2 RELATED SECTIONS

A. Section 04200 - Masonry.

B. Section 05500 - Metal Fabrications: Steel lintels.

C. Section 07900 - Joint Sealers: Perimeter sealant and back-up materials.

D. Section 08410 - Aluminum Entrances and Storefronts.

E. Section 08800 - Glazing.

1.3 REFERENCES

A. AAMA 605.2 - Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

B. ASTM A386 - Zinc Coating (Hot Dip) on Assembled Steel Products.

C. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

E. ASTM E283 - Rate of Air Leakage Through Exterior Windows,

Curtain Walls, and Doors.

F. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

G. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

H. FS RR-W-365 - Wire Fabric (Insect Screening).

I. SSPC - Steel Structures Painting Manual.

1.4 SYSTEM DESCRIPTION

A. Windows: Tubular aluminum sections, shop fabricated, factory pre-finished, vision glass, related flashings, anchorage and attachment devices.

B. Configuration: Outward openings top hinged sash and fixed non-operable.

C. Glazing: Interior.

1.5 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall to a design pressure of 30 lb/sq ft and a suction of 40 lb/sq ft.

B. Limit member deflection to flexure limit of glass with full recovery of glazing materials.

C. System to accommodate, without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.

D. Limit air leakage through assembly to 0.002 cu m/s/sq m of wall area, measured at a reference differential pressure

across assembly of 75 Pa as measured in accordance with ASTM E283.

E. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 136.85 N/sq.M.

F. Maintain continuous air and vapor barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.

G. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.6 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work; installation requirements; and certification.

B. Product Data: Provide component dimensions, anchorage and fasteners, glass, internal drainage details and color samples.
   1. Submit two samples 102 x 152 mm in size illustrating window frame section mullion section screen and frame, pre-finished aluminum surfaces, glass units, glazing materials.
   2. Submit two samples of operating hardware.

C. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

D. Submit independent lab testing reports to certify that products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with AAMA 101.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing commercial aluminum windows with minimum four years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect pre-finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealants when ambient temperature is less than 5 degrees C.

B. Maintain this minimum temperature during and after installation of sealants.

1.11 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

B. Verify that field measurements are as instructed by the manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers offering equivalent Products.
   1. EFCO Corp. Series 2900 P-HC55 Projected and Fixed Thermal Windows
   2. Kawneer Company Inc., Series 8350.
   3. Wausau Metals Corporation Product Series 3250 projected out.

2.2 MATERIALS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper.

B. Sheet Aluminum: ASTM B209; alloy, T3 temper.

C. Fasteners: Stainless steel.

2.3 COMPONENTS

A. Frames: 54 mm wide x 115 mm deep profile, of 3.2 mm thick section; thermally broken with interior portion of frame insulated from exterior portion applied glass stops of snap-on type.

B. Sills: 54 mm thick, extruded aluminum; sloped for positive wash; fit under sash leg to 12 mm beyond wall face; one piece full width of opening jamb angles to terminate sill end.

C. Insect Screens: FS RR-W-365, woven aluminum mesh 18/16 mesh size.

D. Operable Sash Weather Stripping: Neoprene; permanently resilient, profiled to effect weather seal.

E. Fasteners: Stainless steel.

F. Custom extruded sill members as detailed on drawings.

2.4 GLASS AND GLAZING MATERIALS

A. Glass and Glazing Materials: As specified in Section 08800 of Types described below:
   1. Glass in Exterior Lights: Type 1/4" gray tint in exterior pane and 1/4" clear for interior pane.

2.5 SEALANT MATERIALS

A. Sealant and Backing Materials: As specified in Section 07900 of Types described below.

B. Perimeter Sealant: Type S.

C. Sealant Used Within System (Not Used for Glazing): Type Silicone.

2.6 HARDWARE

A. Sash lock: Lever handle with cam lock.

B. Projecting Sash Arms: Stainless steel, friction pivot joints with nylon bearings, removable pivot clips for cleaning.

2.7 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints

flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to ensure concealment from view.

E. Prepare components with internal reinforcement for operating hardware.

F. Provide internal reinforcement in mullions with galvanized steel members to maintain rigidity.

G. Permit internal drainage weep holes and channels to migrate moisture to exterior. Provide internal drainage of glazing spaces to exterior through weep holes.

H. Assemble insect screens of rolled aluminum rectangular tubular sections. Miter and reinforced frame corners. Fit mesh taught in frame into frame and secured. Fit frame with four spring loaded steel pin retainers.

I. Double weatherstrip operable units.

J. Shop glaze window units.

2.8 FINISHES

A. Exterior exposed aluminum surface finish coatings to conform to AAMA 605.2.

B. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION

Modular Design System

A. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

3.2 INSTALLATION

A. Install window frames, glass and glazing and hardware in accordance with manufacturers instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances, aligning with adjacent work.

D. Install sill and sill end angles.

E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Coordinate attachment and seal of perimeter air and vapor barrier materials.

G. Install operating hardware.

H. Install glass and infill panels in accordance with Section 08800, to glazing method required to achieve performance criteria exterior wet/dry method of glazing.

I. Install perimeter sealant to method required to achieve performance criteria Type S, backing materials, and installation criteria in accordance with Section 07900.

3.3 TOLERANCES

A. Maximum Variation from Level or Plumb: 1.5 mm/m non-cumulative or 12 mm/30 m, whichever is less.

3.4 ADJUSTING

Modular Design System

A. Adjust operating hardware for smooth operation.

3.5 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood, hollow steel aluminum doors.

B. Thresholds.

C. Weatherstripping, seals and door gaskets.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 08111 - Standard Steel Frames: Furnish templates for frame preparation.

B. Section 08112 - Standard Steel Doors: Furnish templates for door preparation.

C. Section 08410 - Aluminum Entrances and Storefronts: Furnish lock cylinders for installation.

1.3 RELATED SECTIONS

A. Section 08111 - Standard Steel Doors.

B. Section 08112 - Standard Steel Frames.

C. Section 08331 - Overhead Coiling Doors: Lockable coiling doors.

D. Section 08410 - Aluminum Entrances and Storefronts: Hardware for same except cylinders.

1.4 REFERENCES

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped

People.

B. ADA: Accessibility Guidelines.

C. Local, State and Federal requirements.

D. NFPA 80 - Fire Doors and Windows.

E. AWI - Architectural Woodwork Institute - Quality Standards.

F. NFPA 252 - Fire Tests of Door Assemblies.

G. UL 10B - Fire Tests of Door Assemblies.

H. UL 305 - Panic Hardware.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate locations and mounting heights of each type of hardware.

B. Manufacturer's Data: Submit manufacturer's parts lists, templates, and maintenance instruction.

C. Samples: Submit color and finish samples.

1.6 PROJECT RECORD DOCUMENTS

A. Record actual locations of installed cylinders and their master key code.

1.7 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with the following requirements:
1. ANSI A117.1 - Specifications for Making Buildings and

Facilities Accessible to and Usable by Physically Handicapped People.

2. NFPA 101.
3. NFPA 80.
4. NFPA 252.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Hardware Supplier: Company specializing in supplying commercial door hardware with 10 years documented experience. approved by manufacturer.

C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

1.10 REGULATORY REQUIREMENTS

A. Conform to applicable local code for requirements applicable to fire rated doors and frames.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

C. Deliver keys to Government by security shipment direct from hardware supplier.

1.12 COORDINATION

Modular Design System

A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

1.13 WARRANTY

A. Provide five year warranty under General Provisions.

1.14 MAINTENANCE MATERIALS

A. Provide special wrenches and tools applicable to each different or special hardware component.

B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 PRODUCTS

2.1 SUPPLIERS

A. Corbin & Russwin Architectural Hardware.

B. Yale Security Inc.

C. Schlage Lock, Div. Ingersoll-Rand, Door Hardware Co.

2.2 ACCEPTABLE MANUFACTURERS

A. Hinges: Bommer Industries, Hager Hinge Co., Stanley and McKinney Products Co.

B. Latch Sets: Corbin, Yale, and Schlage.

C. Push/Pulls: Builder Brass Works Corp, H. B. Ives and Trimco. Rockwood Manufacturing Co.

D. Cylinder Locks: Best Lock Corp, Corbin, and Yale.

E. Mortise Locks: Corbin, Yale, and Schlage, cast bronze.

F. Exit Devices: Corbin, Sargent, and Von Durpin

G. Closers: Dorma, LCN and Rixson, Corbin/Russwin.

H. Gasketing: Thresholds, National Guard Prod., Pemko, and Zero International

I. Protection Plates: Baldwin Hdw Corp., H.B. Ives, and Trimco. Rockwood Manufacturing Co.

2.3 KEYING

A. Door Locks: Provide 7 pin tumbler type locksets keyed in like-groups. Master keyed. Grand master keyed to Owner's existing keying system. Include construction keying, control keying with removable core cylinders. Coordinate keying and key turnover with the Contracting Officer.

B. Supply keys in the following quantities:

1. 4 master keys.
2. 2 grand master keys.
3. 2 construction keys.
4. 2 control keys and 2 extra cylinder cores.
5. 4 change keys for each lock bitting.

2.4 KEY CABINET

A. Cabinet Construction: Sheet steel construction, piano hinged door with 5 pin tumbler type lock master keyed to building system.

B. Cabinet Size: Size for project keys plus 10 percent growth.

C. Horizontal metal strips for key hook labeling with clear plastic strip cover over labels.

D. Finish: Baked enamel, beige.

2.5 FINISHES

A. Finishes: Identified in schedule at end of section.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions.

B. Use templates provided by hardware item manufacturer.

C. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.

1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
2. NWWDA Industry Standard I.S.1.7, "Hardware Location for Wood Flush Doors."

3.3 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

A. Adjust hardware for smooth operation.

3.5 PROTECTION OF FINISHED WORK

Modular Design System

A. Do not permit adjacent work to damage hardware or finish.

3.6 SCHEDULES

SET 1
Single Door Non Rated
Office doors with key lockset, closer, BB butts
Each to have:
1-1/2 PR Butts BB1168 - Sec. Stud 4-1/2 x 4-1/2
1 Lockset ML2267 NSR
1 Closer DC2200 - H.O.
1 Kick Plate
1 Mop Plate
1 Wallstop 409
3 Silencers 608

SET 2
Single Door Rated
Office Doors with key lockset, closer, BB butts
Each to have:
1-1/2 PR Butts BB1168 - Sec. Stud 4-1/2 x 4-1/2
1 Lockset ML 2267 NSR
1 Closer DC2200
1 Kick Plate
1 Mop Plate
1 Wallstop 409
3 Silencers 608

SET 3
Single Door Non Rated
Doors with special function lockset. Turn of master or lock up key in inside cylinder locks or unlocks outside knob/lever. BB butts, closer
Each to have:
1-1/2 PR Butts BB1168 SEC Stud 4-1/2 x 4-1/2
1 Lockset ML2242NSR
1 Closer DC2200
1 Wallstop 409
3 Silencers 608
1 Kick Plate
1 Mop Plate

Modular Design System

SET 4

Single Door Rated

Doors with special function lockset. Turn of master or lock up key in inside. Outside knob/lever. BB butts, closer

Each to have:

1-1/2 PR Butts BB1168 SEC Stud 4-1/2 x 4-1/2
1 Lockset ML2242NSR
1 Closer DC2200 SNB
1 Wallstop 409
3 Silencers 608
1 Kick Plate
1 Mop Plate

SET 5

Single Door Non Rated

Door with classroom lockset, closer, lock or unlock by key, inside knob/free

Each to have:

1-1/2 PR Busst BB1168 Sec. Stud 4-1/2 x 4-1/2
1 Lockset ML2255NSR
1 Closer DC2200
OR
1 Closer DC2200 PA (Parallel Arm) (PA)
1 Wallstop 409
3 Silencers 608
1 Kick Plate
1 Mop Plate

SET 6

Single Door Non Rated

Doors with lockset, BB hinges, closer, open with key only, inside knob/lever free.

Each to have:

1-1/2 PR BB Butts 1168 Sec. Stud 4-1/2 x 4-1/2
1 Lockset ML2257NSR
1 Wallstop 409
3 Silencers 608
1 Closer DC2200
1 Mop Plate

SET 7

Modular Design System

Single Door Rated
Doors with lockset, BB hinges, closer, open with key only, inside knob/lever free.
Each to have:
1/2 PR BB Butts 168 Sec. Stud 4-1/2 x 4-1/2
1 Lockset ML2257NSR
1 Wallstop 409
3 Silencers 608
1 Closer DC2200 SNB
1 Mop Plate

SET 8
Single Door Non Rated
Doors with push plate, pull plate, BB butts, closer, deadlock
Each to have:
1-1/2 PR Butts BB1168 4-1/2 x 4-1/2
1 Push Plate 6" x 18"
1 Pull Plate 4" x 16"
1 Closer DC2200
1 Wallstop 409
3 Silencers 608
1 Deadlock DL4017 Center Cyl 60" above bottom of frame
1 Kick Plate
1 Mop Plate

SET 9
Single Exterior Non Rated
Single exterior doors with exit device, closer, weatherstrip - threshold
Each to have:
1-1/2 PR Butts BB1199 4-1/2 x 4-1/2 Sec. Stud
1 Exit Device ED5200 Non Rated Door
  N7 Newport x Hi Security Cylinder
1 Closer P-DC2200 A5 (PA) (Parallel Arm)
  Extra heavy closer with back stop arm (add each for hold open)
1 Threshold (Handicap) Type 896X NGP Alum.
1/4" high - XMSLA
1 Set Weatherstrip Type PF182 NGP Char.

SET 10
Double Exterior Non Rated

Modular Design System

Double exterior doors with exit device, closer, weatherstrip - threshold
Each leaf to have:
1-1/2 PR Butts BB1199 4-1/2 x 4-1/2 Sec Stud
1 Exit Device ED5200
  N7 - Newport x Hi Security Cylinder (ACTIVE DOOR ONLY)
1 Closer P-DC2200 - A5 (PA) (Parallel Arm)
1 Threshold (Handicap) Type 896X NGP Alum.
1/4" high - XMSLA
1 Set Weatherstrip Type PF182 NGP Char.
507 Removable Mullion

SET 11
Interior Double Door Non Rated
Pair of doors with lock, flush bolts, closer, act. door only.
Each to have:
3 PR Butts BB1168 4-1/2 x 4-1/2
1 Lockset ML2242NSR
2 Flush Bolts 555
1 Closer P-DC2200 Parallel Arm-Active Door Only
1 Stop 409
2 Silencers 608
2 Kick Plates
2 Mop Plates

SET 12
Interior Double Door Rated
Pair of doors with lock, flush bolts, closer, Act. door only.
Each to have:
3 PR Butts BB1168 4-1/2 x 4-1/2
1 Lockset ML2242NSR
2 Flush Bolts 555 Automatic
2 Closers DC2200
1 Stop 409
2 Silencers 608
2 Kick Plates
2 Mop Plates

SET 13
Corridor Double Doors Non Rated
Pair corridor doors, interior, locked with exit devices.

Modular Design System

Each to have:
3 PR Butts BB1168 4-1/2 x 4-1/2
1 Exit Device (RHR Active Door) ED 5400 x Newport N7 Trim
1 Exit Device (LHR Inactive Door) ED5400
2 Door Closers DC2200
2 Wallstops 409
2 Silencers 608
2 Kick Plates
2 Mop Plates

SET 14
Corridor Double Door Rated
Pair-Label corridor doors, interior, locked with exit devices. Doors must fit within 3/8" of finish floor.
Each to have:
3 PR Butts BB1168 4-1/2 x 4-1/2
1 Exit Device (RHR-Active Door) - ED5400A x Newport N7 Trim
1 Exit Device (LHR Inactive Door) ED5400A
2 Door Closers DC2200
2 Wallstops 409
2 Silencers 608
2 Kick Plates
2 Mop Plates

SET 15
Single Door Non Rated
Dutch Door
Each to have:
2 PR Butts 1279 Sec. Stud 4-1/2 x 4-1/2
1 Lockset CL3251-IC-NSD (Lower leaf)
1 Deadlock DL 4017-HS (Upper leaf)
1 Flush Extension Bolt 555 - 6" Rod
1 Kick Plate
1 Mop Plate
1 Wallstop with hook
1 Wallstop
4 Silencers

SET 16
Hasp Lock
1 Padlock PD5000-IC-High Security

3.7 DESCRIPTION

KICK PLATES - 8" HIGH DOOR WIDTH MINUS 2"
MOP PLATES - 4" HIGH DOOR WIDTH MINUS 1"
ALL .050 GA

HS = HIGH SECURITY CYLINDER (ADD HS SUFFIX WHERE HS FEATURE IS REQUIRED.

SPECIFY ALUMINUM DOOR HARDWARE WITH THAT SECTION CYLINDERS ONLY IN HARDWARE SECTION.

FINISH

3.8 FINISH

620 SATIN CHROME PLATED BRASS OR BRONZE METAL.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 08800

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glass and glazing for hollow metal work, windows, glazed walls, doors.

1.2 RELATED SECTIONS

A. Section 08111 - Standard Steel Doors: Glazed doors.

B. Section 08211 - Flush Wood Doors: Glazed doors.

C. Section 08410 - Aluminum Entrances and Storefronts.

D. Section 08520 - Aluminum Windows: Glazed windows.

E. Section 10800 - Toilet and Bath Accessories: Mirrors.

1.3 REFERENCES

A. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.

B. ASTM C804 - Use of Solvent-Release Type Sealants.

C. ASTM C864 - Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

D. ASTM C920 - Elastomeric Joint Sealants.

E. ASTM C1036 - Flat Glass.

F. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

G. ASTM E84 - Surface Burning Characteristics of Building

Materials.

H. ASTM E283 - Test Method For Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.

I. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

J. ASTM E546 - Test Method For Frost Point of Sealed Insulating Glass Units.

K. ASTM E576 - Test Method For Dew/Frost Point of Sealed Insulating Glass Units in Vertical Position.

L. ASTM E773 - Test Method for Seal Durability of Sealed Insulating Glass Units.

M. ASTM E774 - Sealed Insulating Glass Units.

N. FGMA - Glazing Manual.

O. FGMA - Sealant Manual.

P. Laminators Safety Glass Association - Standards Manual.

Q. SIGMA - Sealed Insulated Glass Manufacturers Association.

1.4 PERFORMANCE REQUIREMENTS

A. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass to design pressures as indicates for the applications.

B. Limit glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.

1.5 SUBMITTALS: Section 01300 - Submittals: Procedures for submittals.

A. Product Data on Glass Types: Provide structural, physical

and environmental characteristics, size limitations, special handling or installation requirements.

B. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

C. Samples: Submit two samples 300 mm x 300 mm in size, exampling glass units, coloration.

1.6 SUBMITTALS FOR INFORMATION

A. Section 01300 - Submittal Procedures: Procedures for submittals.

B. Certificates: Certify that Products meet or exceed specified requirements.

C. Manufacturer's Certificate: Certify that sealed insulated environmental glass, meets or exceeds specified requirements.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with FGMA Glazing Manual, FGMA Sealant Manual, SIGMA and Laminators Safety Glass Association - Standards Manual for glazing installation methods.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum ten years documented experience approved by manufacturer.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Conditions affecting products on site.

B. Do not install glazing when ambient temperature is less than 50 degrees F.

C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 WARRANTY

A. Provide a five (5) year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

B. Provide a five (5) year warranty to include coverage for delamination of laminated glass and replacement of same.

PART 2 PRODUCTS

2.1 FLAT GLASS MATERIALS

A. Manufacturers:
1. Libbey Owens Ford Designation LOF
2. PPG Industries, Inc. Designation PPG
3. Spectrum Glass Products

B. Float Glass (Type FG-A): ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select; 6 mm minimum thick.

C. Safety Glass (Type FG-B): Clear fully tempered with horizontal tempering laminated with plastic interlayer to ASTM C1172, Kind Clear 1.5 mm thick vinyl inter-layer; conforming to ANSI Z97.1; 7 mm minimum thick.

D. Tinted Glass (Type FG-C): Float type, heat strengthened light reducing in grey color; light transmittance of 42 percent, shading coefficient of 0.66, 6 mm minimum thick.

2.2 SEALED INSULATING GLASS MATERIALS

A. Manufacturers:
1. Libbey Owen Ford Designation LOF
2. PPG Designation PPG
3. Spectrum Glass Products, Inc. Designation

B. Insulated Glass Units (Type SG-A): ASTM E774 and E773;

double pane with silicone sealant edge seal; outer pane of grey tinted glass, inner pane of clear glass, purge interpane space with dry hermetic air; total unit thickness of 25 mm.

C. Edge Seal Construction: Stainless steel, bent and soldered mitered and spigoted corners.

2.3 GLAZING ACCESSORIES

A. Setting Blocks: ASTM C864 Option I Neoprene, 80 to 90 Shore A durometer hardness, length of 25 mm for each square meter of glazing or minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height to suit glazing method and pane weight and area.

B. Spacer Shims: ASTM C864 Option I, Neoprene, 50 to 60 Shore A durometer hardness, minimum 75 mm long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

D. Perform installation in accordance with ASTM C804 for solvent release sealants.

3.3 INSTALLATION - EXTERIOR DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.

B. Place setting blocks at 1/4 points with edge block no more than 150 mm from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

E. Trim protruding tape edge.

3.4 INSTALLATION - INTERIOR DRY METHOD (TAPE AND TAPE)

A. Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 150 mm from corners.

C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

D. Place glazing tape on free perimeter of glazing in same manner described above.

E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

F. Knife trim protruding tape.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Control: Field inspection.

B. Inspection will monitor quality of glazing.

3.6 MANUFACTURER'S FIELD SERVICES

A. Glass and glazing product manufacturers to provide field surveillance of the installation of their Products.

B. Monitor and report installation procedures and unacceptable conditions.

3.7 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Clean glass and adjacent surfaces.

3.8 PROTECTION OF FINISHED WORK

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

3.9 SCHEDULE

A. Exterior Windows: Types FG-C, FG-D, SG-B as scheduled on Drawings, exterior wet/dry method with Type GC-F compound.

B. Exterior Entrances: Types FG-D gray tint 8 mm thick, exterior wet/dry method with Type GC-E compound.

C. Interior Metal Doors: Type FG-A clear float 6 mm thick, interior wet method with Type GC-A compound.

D. Interior Display Cabinets: Type PG-B clear acrylic, interior dry method.

END OF SECTION

SECTION 08840

TRANSLUCENT WALL PANELS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

Translucent wall panels shall be provided in the locations indicated. Fabrication shall be performed in the shop using glass fiber reinforced polymer faces bonded to an aluminum grid core of the thickness specified.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Data

Translucent walls panels and aluminum framing system.

Data composed of catalog cuts, brochures, maintenance directions, and compatible cleaning agents.

Instructions

Installation

Manufacturer's installation instructions for translucent wall panels and framing system.

Certificates

Translucent wall panels and framing system.

Certificates stating that the panel face sheets and framing material meet the specified requirements.

Samples

Translucent wall panels and framing system, horizontal batten framing sections, Sealants

Three samples of each indicated material. Sample wall panel shall be of adequate size to show representative section of the complete system. Other samples shall be minimum 300 mm x 300 mm.

1.3 DELIVERY AND STORAGE

Wall panels, frames, sealants and primers shall be delivered to the site in rigid structural units in manufacturer's unopened containers and shall be stored in safe, dry locations and shall not be unpacked until needed for installation.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Translucent Panels

Panels shall be 2 3/4" thick and consist of glass fiber reinforced polymer faces bonded to a mechanically interlocked aluminum grid core. Exterior face shall be color stable through the full thickness and shall include a permanent glass erosion barrier and field refinishable and restorable self-cleaning surface. U factor for panels shall be .15.

2.1.2 Aluminum Framing System

Aluminum grid core shall be 6063-T6 aluminum I-beams with 12 mm flange width, mechanically interlocked.

PART 3 EXECUTION

3.1 INSTALLATION

Head, jamb sills and vertical closures shall be manufacturer's standard clamping/framing members with corrosion resistant finish per AAMA 605.2. Closures shall maintain continuous clamping. Sealing tapes shall be factory applied to system. All fasteners shall be stainless steel.

3.2 CLEANING

The plastic surfaces shall be clean and free of smears, spatters, scratches, and other defacement at the time the work is accepted. Cleaning shall be in accordance with the manufacturer's recommendation.

-- End of Section --

SECTION 09111

METAL STUD FRAMING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formed metal stud framing at interior locations.

B. Framing accessories.

1.2 RELATED SECTIONS

A. Section 05400 - Cold-Formed Metal Framing: Exterior metal stud framing.

B. Section 06114 - Wood Blocking and Curbing: Rough wood blocking within stud framing.

C. Section 09260 - Gypsum Board System: Wall sheathing.

D. Section 07213 - Batt and Blanket Insulation: Insulation within framing members.

E. Section 07900 - Joint Sealers.

F. Section 09260 - Gypsum Board Systems: Metal studs for partitioning.

1.3 REFERENCES

A. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

C. ASTM A591 - Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated.

D. ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Application of Gypsum Board.

E. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board.

F. GA 203 - Installation of Screw-Type Steel Framing Members to Receive Gypsum Board.

G. Metal Framing Manufacturers Association (MFMA) - Guidelines for the Use of Metal Framing.

H. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

1.4 SYSTEM DESCRIPTION

A. Metal stud framing system for exterior wall metal wall panels, with exterior sheathing specified in Section 05400, batt insulation specified in Section 07213, interior gypsum board specified in Section 09260.

B. Metal stud framing system for interior walls, with batt type acoustic insulation specified in Section 09260 interior gypsum board specified in Section 09260.

C. Design wall system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

D. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate component details, framed openings, anchorage to structure, type and location of fasteners, and

accessories or items required of other related work. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement to framing connections.

B. Product Data: Provide data describing standard framing member materials and finish, product criteria, load charts, and limitations.

C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with GA 203, MFMA and ASTM C754.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with minimum six years documented experience approved by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Dietrich Industries, Inc.

B. Gold Bond Building Products Division, National Gypsum Co.

C. Unimast Incorporated

2.2 STUD FRAMING MATERIALS

A. Studs: ASTM A525 and C645, non-load bearing rolled steel, channel shaped, punched for utility access, as indicated on the drawings.
1. Minimum Thickness: 25 gage.

B. Runners: Of same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.

C. Furring and Bracing Members: "Z" and hat type. Of same material as studs; thickness to suit purpose.

D. Fasteners: GA 203. Self drilling, self tapping screws.

E. Sheet Metal Backing: 20 gage (0.9 mm thick) galvanized steel for reinforcement of corners.

F. Anchorage Devices: Power actuated.

G. Acoustic Sealant: As specified in Section 09260.

H. Touch-Up Primer for Galvanized Surfaces: SSPC - Paint 20 Type I Inorganic zinc rich.

2.3 FINISHES

A. Studs: Galvanize to G90 coating class.

B. Tracks and Headers: Galvanize to G90 coating class.

C. Accessories: Same finish as framing members. ASTM A123, hot dip galvanized to 380 gm/sq m.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that conditions are ready to receive work.

B. Verify that rough-in utilities are in proper location.

3.2 ERECTION

A. Align and secure top and bottom runners at 600 mm oc.

B. Place two beads of acoustical sealant between runners and substrate to achieve an acoustical seal.

C. Place two beads of acoustic sealant between studs and adjacent vertical surfaces to achieve an acoustical seal.

D. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

E. Install studs vertically at 400 mm oc.

F. Align stud web openings horizontally.

G. Secure studs to tracks using crimping method. Do not weld.

H. Stud splicing not permissible.

Modular Design System

I. Fabricate corners using a minimum of three studs.

J. Double stud at wall openings, door and window jambs, not more than 50 mm from each side of openings.

K. Brace stud framing system rigid.

L. Coordinate erection of studs with requirements of door frames, window frames, and install supports and attachments.

M. Coordinate installation of wood bucks, anchors, and wood blocking with electrical and mechanical work to be placed within or behind stud framing.

N. Blocking: Secure wood blocking to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and any equipment anchored to wall.

O. Refer to Drawings for indication of partitions extend stud framing through the ceiling to the structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.

P. Coordinate placement of insulation in stud spaces made inaccessible after stud framing erection.

3.3 ERECTION TOLERANCES

A. Maximum Variation From True Position: 3 mm.

B. Maximum Variation of any Member from Plane: 3 mm.

C. Maximum Variation From Plumb: 3 mm.

END OF SECTION

SECTION 09260

GYPSUM BOARD SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal stud wall framing.

B. Metal channel ceiling framing.

C. Acoustical insulation.

D. Gypsum board.

E. Gypsum sheathing.

F. Cementitious backer board.

G. Taped and sanded joint treatment.

1.2 RELATED SECTIONS

A. Section 05400 - Cold Formed Metal Framing.

B. Section 06114 - Wood Blocking and Curbing: Wood blocking for support of Toilet and Bath Accessories.

C. Section 07213 - Batt Insulation: Thermal insulation.

D. Section 08112 - Standard Steel Frames.

E. Section 09900 - Painting: Surface finish.

1.3 REFERENCES

A. ASTM C36 - Gypsum Wallboard.

B. ASTM C79 - Gypsum Sheathing Board.

C. ASTM C442 - Gypsum Backing Board and Core Board.

D. ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.

E. ASTM C514 - Nails for the Application of Gypsum Wallboard.

F. ASTM C557 - Adhesive for Fastening Gypsum Wallboard to Wood Framing.

G. ASTM C630 - Water Resistant Gypsum Backing Board.

H. ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

I. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

J. ASTM C754 - Installation of Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.

K. ASTM C840 - Application and Finishing of Gypsum Board.

L. ASTM C1002 - Steel Drill Screws for the Application of Gypsum Board.

M. ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

N. ASTM E119 - Fire Tests of Building Construction and Materials.

O. GA-201 - Gypsum Board for Walls and Ceilings.

P. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.

Q. GA-600 - Fire Resistance Design Manual.

Modular Design System

1.4 SYSTEM DESCRIPTION

A. Acoustical Attenuation for Identified Interior Partitions: Required STC in accordance with ASTM E90 are indicated on the Drawings.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate special details associated with fireproofing and acoustical seals.

B. Product Data: Provide data on metal framing, gypsum board, joint tape.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C840, GA-201, GA-216 and GA-600. Refer to the installation guide of one of the listed manufacturers hereinafter for installation of gypsum sheathing.

1.7 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum five years documented experience approved by manufacturer.

1.8 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated assemblies in conjunction with Section 05400 and 09111 as follows:
   1. Fire Rated Partitions: Listed assembly by UL
   2. Fire Rated Structural Column Framing: Listed assembly by UL.
   3. Fire Rated Structural Beam Framing: Listed assembly by UL.

PART 2 PRODUCTS

2.1 MANUFACTURERS - GYPSUM BOARD SYSTEM

Modular Design System

A. Acceptable manufacturers offering equivalent products.
   1. Georgia Pacific Corp.
   2. Gold Bond Building Products Div., National Gypsum Co.
   3. United States Gypsum Company

2.2 FRAMING MATERIALS

A. Studs and Tracks: ASTM C645; GA-216 and GA-600; galvanized sheet steel, 25 gage 0.55 mm) thick, C shape.

B. Furring, Framing and Accessories: ASTM C645. GA-216 and GA-600.

C. Fasteners: ASTM C1002.

D. Anchorage to Substrate: Tie wire, nails, screws and other metal supports, of type and size to suit application; to rigidly secure materials in place.

2.3 GYPSUM BOARD MATERIALS

A. Standard Gypsum Board: ASTM C36; 16 mm thick, maximum permissible length; ends square cut, tapered edges.

B. Fire Rated Gypsum Board: ASTM C36; fire resistive type, UL rated; 16 mm thick, maximum permissible length; ends square cut, tapered edges.

C. Moisture Resistant Gypsum Board: ASTM C630; 16 mm thick, maximum permissible length; ends square cut, tapered and beveled edges.

D. Gypsum Sheathing Core Board (faced both sides with fiberglass mat): Conform to ASTM C79 and in accordance with ASTM C1177 with glass mats both sides and long edges. Size: 16 mm thick by 4' by 8', 9' or 10'. Flame spread O, smoke developed O, when tested in accordance with ASTM E 84.

E. Cementitious Backing Board: High density, glass fiber reinforced, 13 mm thick; 50 mm wide, coated glass fiber tape for joints and corners.

Modular Design System

2.4 ACCESSORIES

A. Acoustical Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced, thickness as required to fill the cavity of the partition where indicated. Minimum STC rating for wall shall be 47.

B. Acoustical Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

C. Corner Beads: Metal.

D. Edge Trim: See drawing for type required.

E. Joint Materials: ASTM C475; GA 201 and GA 216; reinforcing tape, joint compound, adhesive, and water.

F. Fasteners: ASTM C1002, Type S12.

G. Building paper: No. 15, non perforated, asphalt saturated felt complying with ASTM D226, Type 1 or equivalent.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

3.2 METAL STUD INSTALLATION

A. Install studs in accordance with ASTM C754 or manufacturer's instructions also, see Section 09111 - Metal Stud Framing System.

B. Metal Stud Maximum Spacing: 16 inches (400 mm) on center.

C. Refer to Drawings for indication of partitions extend stud framing through the ceiling to the structure above. Maintain

clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.

D. Door Opening Framing: Install double studs at door frame jambs. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.

E. Blocking: Nail wood blocking to studs. Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, and toilet accessories.

3.3 WALL FURRING INSTALLATION

A. Erect wall furring for direct attachment to concrete block walls.

B. Erect furring channels vertically; space maximum 400 mm on center, not more than 100 mm from floor and ceiling lines. Secure in place on channel flanges at maximum 600 mm on center.

C. Install thermal insulation in conjunction with Section 07213 vertically and hold in place with Z-furring channels spaced maximum 600 mm on center, not more than 75 mm from external corners and 300 mm at internal corners. Secure Z-furring channels maximum 600 mm on center.

3.4 FURRING FOR FIRE RATINGS

A. Install furring as required for fire resistance ratings indicated and to GA-600 requirements.

3.5 NOT USED

3.6 CEILING FRAMING INSTALLATION

A. Install in accordance with ASTM C754 and manufacturer's instructions.

B. Coordinate location of hangers with other work.

C. Install ceiling framing independent of walls, columns, and above ceiling work.

D. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 600 mm past each end of openings.

E. Laterally brace entire suspension system.

3.7 ACOUSTICAL ACCESSORIES INSTALLATION

A. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

B. Install acoustical sealant within partitions in accordance with manufacturer's instructions.

3.8 GYPSUM BOARD INSTALLATION

A. Install gypsum board in accordance with manufacturer's instructions.

B. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Erect single layer fire rated gypsum board, with edges and ends occurring over firm bearing.

D. Erect exterior gypsum sheathing horizontally, with edges butted tight and ends occurring over firm bearing.

E. Use screws when fastening gypsum board to metal furring or framing.

F. Double Layer Applications: Secure second layer to first with

fasteners. Apply adhesive in accordance with manufacturer's instructions.

G. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer.

H. Treat cut edges and holes in moisture resistant gypsum board with sealant.

I. Place control joints consistent with lines of building spaces as directed.

J. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

K. Install backing board over metal studs in accordance with manufacturer's instructions.

3.9 JOINT TREATMENT

A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

B. Feather coats onto adjoining surfaces so that camber is maximum 0.8 mm.

C. Tape joints and corners of cementitious backing board.

3.10 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 3 mm in 3 m in any direction.

END OF SECTION

SECTION 09306

FLOOR TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ceramic and Quarry tile floor and base finish using the thinset and mortar bed application method.

B. Threshold at door opening.

1.2 RELATED SECTIONS

A. Section 07900 - Joint Sealers: Mildew resistant sealant.

B. Section 09307 - Wall Tile.

C. Section 15430 - Plumbing Specialties: Floor drains.

D. Section 15440 - Plumbing Fixtures: Shower pan receptor.

1.3 REFERENCES

A. ANSI A108.1 - Installation of Ceramic Tile with Portland Cement Mortar.

B. ANSI A108.3 - Quarry Tile and Paver Tile Installed With Portland Cement Mortar.

C. ANSI A108.4 - Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive.

D. ANSI A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.

E. ANSI A108.6 - Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy.

F. ANSI A108.8 - Installation of Ceramic Tile with Chemical

Resistant Furan Mortar and Grout.

G. ANSI A108.10 - Installation of Grout in Tilework.

H. ANSI A118.1 - Dry-Set Portland Cement Mortar.

I. ANSI A118.4 - Latex-Portland Cement Mortar.

J. ANSI A118.5 - Chemical Resistant Furan Mortars and Grouts for Tile Installation.

K. ANSI A118.6 - Ceramic Tile Grouts.

L. ANSI A136.1 - Organic Adhesives for Installation of Ceramic Tile.

M. ANSI A137.1 - Standard Specifications for Ceramic Tile.

N. TCA (Tile Council of America) - Handbook for Ceramic Tile Installation.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.

B. Product Data: Provide instructions for using adhesives and grouts.

C. Samples: Mount tile and apply grout on two plywood panels, 304.8 X 304.8 in size illustrating pattern, color variations, and grout joint size variations.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements. ANSI A137.1.

1.5 MAINTENANCE DATA

A. Maintenance Data: Include recommended cleaning methods,

cleaning materials, stain removal methods, and polishes and waxes.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A137.1.

B. Conform to TCA Handbook, ANSI A108.1, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.10.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum four years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum four years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover.

B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install adhesives in an unventilated environment.

B. Maintain 10 degrees C during installation of mortar materials.

PART 2 PRODUCTS

2.1 TILE MANUFACTURERS

A. American Olean Tile Co., Inc.

Modular Design System

B. Dal-Tile Corp.

C. Monarch Tile Manufacturing, Inc.

2.2 CERAMIC TILE MATERIALS

A. Ceramic Mosaic Floor Tile: TCA A137.1, conforming to the following:

1.	Moisture Absorption	0 to 0.5 percent
2.	Size	50.8 X 5.08 X 6.35 mm
3.	Shape	square
4.	Edge	cushioned
5.	Surface Finish	unglazed slip resistant
6.	Color	as selected

2.3 PAVER MATERIALS

A. Paver Tile: TCA A137.1, conforming to the following:

1.	Moisture Absorption	0.5 to 3.5 percent
2.	Size	203 mm x 203 mm x 12.7 mm
3.	Shape	square
4.	Edge	square
5.	Surface Finish	glazed non-slip
6.	Color	as selected

2.4 BASE MATERIALS

A. Base: Match floor tile for moisture absorption, surface finish, and color:

1.	Size	50.8 mm x 50.8 mm x 6.35 mm
2.	Top Edge	bullnosed
3.	Internal Corner	coved
4.	External Corner	bullnosed

2.5 ADHESIVE MATERIALS

A. Manufacturers:
1. Bostik Construction Products, Div. Product: Hydroment
2. Laticrete International, Inc.
3. Mapei Corporation

B. Organic Adhesive: ANSI A136.1, Type I thinset bond type.

2.6 MORTAR MATERIALS

A. Manufacturers:
1. Bostik Construction Products, Div., Product: Hydroment
2. Laticrete International, Inc.
3. Mapei Corporation

B. Mortar Materials: ANSI A118.1 Dry Set, Portland cement, sand, latex additive, and water.

2.7 GROUT MATERIALS

A. Manufacturers:
1. Bostik Construction Products, Div., Product: Hydroment
2. Laticrete International, Inc.
3. Mapei Corporation

B. Grout: ANSI A118.6, tile grout, color as selected.

2.8 ACCESSORIES

A. Thresholds: Marble complying with ASTMC 503 requirements, type, white color, honed finish, 50.8 mm x 19.05 mm size by full width of wall or frame opening, beveled one side, radiused edges from bevel to vertical face.

2.9 MORTAR MIX AND GROUT MIX

A. Mix and proportion cementitious materials for site made slurry coat, mortar bed and bond coat.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

3.2 PREPARATION

A. Protect surrounding work from damage or disfiguration.

B. Vacuum clean surfaces.

C. Seal substrate surface cracks with filler.

D. Apply conditioner to substrate surfaces in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - THINSET METHOD

A. Install adhesive tile, thresholds, and grout in accordance with manufacturer's instructions.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Place thresholds edge strips at exposed tile edges, locations indicated.

D. Cut and fit tile tight to penetrations through tile. Form corners and bases neatly. Align floor, base joints.

E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

F. Sound tile after setting. Replace hollow sounding units.

G. Keep control joints free of adhesive or grout. Apply sealant to joints.

H. Allow tile to set for a minimum of 48 hours prior to grouting.

I. Grout tile joints.

J. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.3 INSTALLATION - MORTAR BED METHOD - WHERE INDICATED

Modular Design System

A. Install mortar bed, tile and grout in accordance with manufacturer's instructions.

B. Apply mortar bed over indicated surfaces to a thickness of 31.75 mm.

C. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

D. Place thresholds edge strips at exposed tile edges. locations indicated.

E. Cut and fit tile tight to penetrations through tile. Ensure finish trim will cover cut tile edges. Form corners and bases neatly. Align floor, base joints.

F. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar or excess grout.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control joints free of mortar or grout. Apply sealant to joints.

I. Allow tile to set for a minimum of 48 hours prior to grouting.

J. Grout tile joints.

K. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.4 CLEANING

A. Clean tile and grout surfaces.

3.5 PROTECTION OF FINISHED WORK

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 09307

WALL TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ceramic tile wall finish using the thinset application method.

B. Cementitious backing board.

1.2 RELATED SECTIONS

A. Section 04311 - Concrete Masonry Units: Wall substrate surface.

B. Section 09220 - Portland Cement Plaster: Base coat for tile finish.

C. Section 07900 - Joint Sealers: Mildew resistant sealant.

D. Section 09306 - Floor Tile.

E. Section 15440 - Plumbing Fixtures: Shower pan receptor.

1.3 REFERENCES

A. ANSI A108.1 - Installation of Ceramic Tile with Portland Cement Mortar.

B. ANSI A108.3 - Quarry Tile and Paver Tile Installed With Portland Cement Mortar.

C. ANSI A108.4 - Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive.

D. ANSI A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.

E. ANSI A108.10 - Installation of Grout in Tilework.

F. ANSI A118.1 - Dry-Set Portland Cement Mortar.

G. ANSI A118.4 - Latex-Portland Cement Mortar.

H. ANSI A118.5 - Chemical Resistant Furan Mortars and Grouts for Tile Installation.

I. ANSI A118.6 - Ceramic Tile Grouts.

J. ANSI A136.1 - Organic Adhesives for Installation of Ceramic Tile.

K. ANSI A137.1 - Standard Specifications for Ceramic Tile.

L. ASTM C847 - Metal Lath.

M. TCA (Tile Council of America) - Handbook for Ceramic Tile Installation.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate tile layout, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.

B. Product Data: Provide instructions for using adhesives and grouts.

C. Samples: Mount tile and apply grout on two plywood panels, 457.2 x 457.2 in size illustrating pattern, color variations, and grout joint size variations.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements. ANSI A137.1.

1.5 MAINTENANCE DATA

A. Maintenance Data: Include recommended cleaning methods,

cleaning materials, stain removal methods, and polishes and waxes.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A137.1.

B. Conform to TCA Handbook, ANSI A108.1, ANSI A108.4, ANSI A108.5, ANSI A108.10.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum four years documented experience approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather and stored under cover.

B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install adhesives in an unventilated environment.

B. Maintain 10 degrees C during installation of mortar materials.

PART 2 PRODUCTS

2.1 TILE MANUFACTURERS

Modular Design System

A. American Olean Tile Co., Inc.

B. Dal-Tile Corp.

C. Monarch Tile Manufacturing, Inc.

2.2 CERAMIC TILE MATERIALS

A. Ceramic Mosaic Wall Tile: ANSI A137.1, conforming to the following:

1.	Moisture Absorption	0 to 0.5 percent
2.	Size	152.4 mm x 152.4 mm x 6.35 mm
3.	Shape	square
4.	Edge	cushioned
5.	Surface Finish	glazed
6.	Color	as selected

2.3 ADHESIVE MATERIALS

A. Manufacturers:

1. Bostik Construction Products, Div. Product: Hydroment
2. Laticrete International, Inc.
3. Mapei Corporation

B. Organic Adhesive: ANSI A136.1, Type I thinset bond type for installation of ceramic tile on cement backer board or water-resistant gypsum board.

2.4 MORTAR MATERIALS

A. Manufacturers:

1. Bostik Construction Products, Div. Product: Hydroment
2. Laticrete International, Inc.
3. Mapei Corporation

B. Mortar Materials: ANSI A118.4 Latex Modified, Portland cement, sand, latex additive, and water for installation of ceramic tile on C.M.U.

Modular Design System

2.5 GROUT MATERIALS

A. Manufacturers:
   1. Bostik Construction Products, Div. Product: Hydroment
   2. Laticrete International, Inc.
   3. Mapei Corporation

B. Grout: ANSI A118.6, tile grout, color as selected.

2.6 ACCESSORIES

A. Membrane: 6.9 kg asphalt saturated felt.

B. Backing Board: High density, cementitious, glass fiber reinforced, 12.7 mm thick; 50.8 mm wide coated glass fiber tape for joints and corners; Dens-Shield manufactured by Georgia Pacific Corporation.

2.7 MORTAR MIX AND GROUT MIX

A. Mix and proportion cementitious materials for site made slurry coat, mortar bed and bond coat.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

3.2 PREPARATION

A. Protect surrounding work from damage or disfiguration.

B. Vacuum clean surfaces.

C. Seal substrate surface cracks with filler.

3.3 INSTALLATION - THINSET METHOD

A. Install adhesive tile and grout in accordance with manufacturer's instructions.

B. Install backing board over metal studs in accordance with board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.

C. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

D. Cut and fit tile tight to penetrations through tile. Form corners and bases neatly. Align floor, base and wall joints.

E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

F. Form internal angles coved and external angles bullnosed.

G. Install ceramic accessories rigidly in prepared openings.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control joints free of adhesive or grout. Apply sealant to joints.

J. Allow tile to set for a minimum of 48 hours prior to grouting.

K. Grout tile joints.

L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.4 INSTALLATION - MORTAR BED METHOD

A. Install mortar bed, tile, and grout in accordance with manufacturer's instructions.

B. Install membrane; lap edges and ends.

C. Apply mortar bed over concrete masonry units (CMU) surfaces to a thickness of 15.8 mm.

D. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

E. Form internal angles coved and external angles bullnosed.

F. Cut and fit tile tight to penetrations through tile. Ensure finish trim will cover cut tile edges. Form corners and bases neatly.

G. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar or excess grout.

H. Install ceramic accessories rigidly in prepared openings.

I. Sound tile after setting. Replace hollow sounding units.

J. Keep control joints free of mortar or grout. Apply sealant to joints.

K. Allow tile to set for a minimum of 48 hours prior to grouting.

L. Grout tile joints.

M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.5 CLEANING

A. Clean work under provisions.

B. Clean tile and grout surfaces.

END OF SECTION

SECTION 09511

SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system and perimeter trim.

B. Acoustical panels.

C. Non-fire rated assembly.

1.2 RELATED SECTIONS

A. Section 07213 - Batt Insulation.

B. Section 10651 - Operable Panel Partitions: Acoustical partition system.

C. Section 15330 - Wet Pipe Sprinkler System, Fire Protection: Sprinkler heads in ceiling system.

D. Section 15940 - Air Outlets and Inlets: Air diffusion devices in ceiling system.

E. Section 16510 - Interior Luminaires: Light fixtures in ceiling system.

F. Section 16721 - Fire Alarm Systems: Fire alarm components in ceiling system.

1.3 REFERENCES

A. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

B. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

Modular Design System

C. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

D. ASTM E580 - Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.

E. ASTM E1264 - Classification of Acoustical Ceiling Products.

F. Ceilings and Interior Systems Contractors Association (CISCA) - Acoustical Ceilings: Use and Practice.

G. UL - Fire Resistance Directory and Building Material Directory.

1.4 SYSTEM DESCRIPTION

A. Suspension system to rigidly secure acoustical ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to acoustical system.

B. Product Data: Provide data on metal grid system components and acoustical units.

C. Samples:

1. Submit two samples full size illustrating material and finish of acoustical units.

2. Submit two samples each, 305 mm long, of suspension system main runner, cross runner, edge trim, and suspension wires.

D. Manufacturer's Installation Instructions: Indicate special

procedures and perimeter conditions requiring special attention.

1.6 QUALIFICATIONS

A. Grid Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum four years documented experience.

B. Acoustical Unit Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum four years documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain uniform temperature of minimum 60 degrees F and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.8 SEQUENCING

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Install acoustical units after interior wet work is dry.

PART 2 PRODUCTS

2.1 MANUFACTURERS - SUSPENSION SYSTEM

A. Armstrong World Industries, Inc.

B. Chicago Metallic Corporation

C. USG Interiors, Inc.

2.2 SUSPENSION SYSTEM MATERIALS

A. Non-fire Rated Grid: ASTM C635, intermediate duty; exposed

Modular Design System

T components die cut and interlocking.

B. Grid Materials: Commercial quality cold rolled steel with galvanized coating. Cold rolled aluminum.

C. Exposed Grid Surface Width: 25 and 15 mm.

D. Grid Finish: As indicated.

E. Accessories: Stabilizer bars, clips, splices, edge moldings required for suspended grid system.

F. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

2.3 MANUFACTURERS - ACOUSTICAL UNITS

A. Armstrong World Industries, Inc.

B. Celotex: The Celotex Corporation.

C. USG Interiors, Inc.

Modular Design System

2.4 ACOUSTICAL UNIT MATERIALS

A. Acoustical Panels: ASTM E1264

1. Size: 600 mm x 600 mm
2. Thickness: 19 mm
3. Light Reflectance: 75 percent
4. NRC Range: .65 to .75
5. CAC Range: 40 - 44
6. Fire Hazard Classification: 25
7. Joint: Donn DX
8. Edge: Shadowline Bevel
9. Surface Color: As indicated.
10. Surface Finish: Factory applied paint.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - LAY-IN GRID SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636 and as supplemented in this section.

B. Install system in accordance with ASTM E580.

C. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.

D. Locate system on room axis according to reflected plan.

E. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.

F. Supply hangers or inserts for installation to Section 09511 with instructions for their correct placement.

G. Provide hanger clips for installation of grid suspension system after structure has been erected. Provide additional hangers and inserts as required. Do not support lay-in grid suspension system from steel decks.

H. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

I. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

J. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.

K. Do not eccentrically load system, or produce rotation of runners.

L. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions.

3.3 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Install units after above ceiling work is complete.

D. Install acoustical units level, in uniform plane, and free from twist, warp and dents.

E. Cut panels to fit irregular grid and perimeter edge trim. Panel edge. Double cut and field paint exposed edges of

tegular units.

F. Where round obstructions occur, provide preformed closers to match edge molding.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Flat and Level Surface: 3 mm in 3 m.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09650

RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

1.2 RELATED SECTIONS

A. Section 04311 - Concrete Masonry Units.

B. Section 09260 - Gypsum Board System.

1.3 REFERENCES

A. ASTM E84 - Surface Burning Characteristics of Building Materials.

B. ASTM F1066 - Vinyl Composition Floor Tile.

C. FS L-F-475 - Floor Covering, Vinyl Surface (Tile and Roll), with Backing.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate borders, patterns, and direction of the grain.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

C. Samples:

1. Submit two samples, 305 mm x 305 mm in size illustrating color and pattern for each floor material for each color

specified.

2. Submit two inch long samples of base material for each color specified.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to the site in original unopened packages, bundles or containers and with all labels intact. Resilient flooring shall be stored in fully covered, well ventilated areas and protected from extreme changes in temperature and humidity. Temperature and humidity in the storage area shall closely approximate the temperature and humidity of the rooms in which the flooring is to be installed.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Store materials for three days prior to installation in area of installation to achieve temperature stability.

B. Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

1.7 MAINTENANCE DATA

A. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

PART 2 PRODUCTS

2.1 MATERIALS - TILE FLOORING

A. Vinyl Composition Tile: ASTM F1066:

Modular Design System

1. Size: 305 mm x 305 mm
2. Thickness: 3 mm
3. Design: As indicated.
4. Manufacturers:

    a) Armstrong World Industries, Inc.
    b) Azrock Industries, Inc.
    c) Kentile Floors Inc.

2.2 MATERIALS - BASE

A. Base: FS SS-W-40, Rubber

1. Height: 101.8 mm
2. Thickness: 3 mmthick
3. Length: Roll.
4. Manufacturers:
    a) Flexco Company
    b) Roppe Corporation
    c) Johnsonite, Div of Duramex, Inc.

B. Base Accessories: Premolded end stops and external corners, of same material, size, and color as base.

2.3 ACCESSORIES

A. Subfloor Filler: Type recommended by adhesive material manufacturer.

B. Primers and Adhesives: Types recommended by flooring manufacturer.

C. Edge Strips: Flooring material.

D. Cant Strip: Metal.

E. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting.

B. Verify floor and lower wall surfaces are free of substances that may impair adhesion of new adhesive and finish materials.

3.2 PREPARATION

A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is cured.

C. Vacuum clean substrate.

3.3 INSTALLATION - TILE FLOORING

A. Install in accordance with manufacturer's instructions.

B. Mix tile from container to ensure shade variations are consistent when tile is placed.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Set flooring in place, press with heavy roller to attain full adhesion.

E. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

F. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.

G. Install resilient edge strips at unprotected or exposed edges, and where flooring terminates.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 INSTALLATION - BASE

A. Fit joints tight and vertical. Maintain minimum measurement of 460 mm between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tight to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.5 CLEANING

A. Remove access adhesive from floor, base, and wall surfaces without damage.

B. Clean, seal, and wax floor and base surfaces in accordance with manufacturer's instructions.

3.6 PROTECTION OF FINISHED WORK

A. Prohibit traffic on floor finish for 48 hours after installation.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 09690

CARPET TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet tiles.

B. Matching roll carpet.

C. Accessories.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete: Floor substrate surface.

B. Section 09650 - Resilient Flooring: termination edging of adjacent floor finish.

C. Section 09260 - Gypsum Board System: Wall materials to receive application of base.

D. Section 09650 - Resilient Flooring: Base finish.

1.3 REFERENCES

A. ASTM D2859 - Test Method for Flammability of Finished Textile Floor Covering Materials.

B. ASTM E84 - Surface Burning Characteristics of Building Materials.

C. ASTM E648 - Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

D. NFPA 253 - Test for Critical Radiant Flux of Floor Covering Systems.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate layout of joints, direction of carpet weave, and transitions to other materials.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the specified carpet in this Section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum six years documented experience. and approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Conform to NFPA 253 ASTM E648 Class II for flooring radiant panel test.

B. Conform to ASTM D2859 for surface flammability ignition test.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Store materials for 3 days prior to installation in area of installation, to achieve temperature stability.

B. Maintain minimum 21 degrees C ambient temperature three days prior to, during and 24 hours after installation materials.

1.8 MAINTENANCE DATA

Modular Design System

A. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

PART 2 PRODUCTS

2.1 MANUFACTURERS - CARPET TILE

A. Collins & Aikman

2.2 CARPET TILE TUFTED AND FUSION BONDED

A. CPT-1: Manufactured in one color dye lot, conforming to the following criteria:

Pile Fiber	100% CF Antron Legacy Nylon
Rows per Inch	11.0
Gage	1/10"
Wire Height	3 mm
Pile Weight	678 gm/m^2
Density Factor	123,076 kilotex
Stitch Count	132
Light Fastness	5
Primary Backing Material	Woven Synthetics
Primary Backing Weight	3.5 oz/sq yd
Laminate	Sealant Vinyl
Laminate Weight	42.9 oz/sq yd
Secondary Backing Material	Fiberglass reinforced closed cell
Secondary Backing Weight	118.40 oz/sq yd
Total Weight	138.40 oz/sq yd
Size	460 mm x 460 mm
Color	As indicated
Style	Infinity

B. CPT-2: Tufted and fusion bonded, Plexus Accent, manufactured in one color dye lot, conforming to the following criteria:

Pile Fiber	100% CF Antron Legacy Nylon
Rows per Inch	11.0

Modular Design System

Gage	1/10"
Wire Height	3 mm
Pile Weight	678 gm/m^2
Density Factor	169,101 kilotex
Stitch Count	132
Light Fastness	5
Primary Backing Material	Woven Synthetics
Primary Backing Weight	3.5 oz/sq yd
Laminate	Sealant Vinyl
Laminate Weight	31.24 oz/sq yd
Secondary Backing Material	Fiberglass reinforced closed cell
Secondary Backing Weight	72 oz/sq yd
Total Weight	138.74 oz/sq yd
Size	460 mm x 460 mm
Color	As indicated
Style	Plexus Accent

2.3 ACCESSORIES

A. Sub-Floor Filler: Type recommended by flooring material manufacturer.

B. Primers and Adhesives: Recommended by carpet manufacturer. Releasable type.

C. Edge Strips: Plastic type, black finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 6 mm in 3 m, and are ready to receive work.

B. Verify concrete floors are dry to a maximum moisture content of 7 percent; and exhibit negative alkalinity, carbonization, or dusting.

3.2 PREPARATION

A. Remove subfloor ridges and bumps. Fill minor or local low

spots, cracks, joints, holes, and other defects with subfloor filler.

B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

C. Vacuum clean substrate.

3.3 INSTALLATION

A. Install carpet tile accessories and adhesive in accordance with manufacturer's instructions.

B. Integrate and blend carpet from different cartons to ensure minimal variation in color match.

C. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

D. Lay carpet tile to ashlar pattern, tile direction parallel to next unit, set parallel to building lines.

E. Locate change of color or pattern between rooms under door centerline.

F. Fully adhere carpet tile to substrate.

G. Bind cut edges where not concealed by edge strips.

3.4 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

3.5 PROTECTION OF FINISHED WORK

A. Protect finished Work.

B. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 09706

INDUSTRIAL FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM C 722	(1994) Chemical-Resistant Resin Monolithic Surfacings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99	(1996) Health Care Facilities

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Data

Urethane-Based Flooring System for hangar floor

Flooring manufacturer's descriptive data, mixing, proportioning, and installation instructions. Maintenance literature for urethane based flooring shall be included.

Drawings

Flooring System

Drawings indicating the type and layout of the floor system.

Reports

Testing

Reports of tests for impact resistance, thermal shock, flexibility chemical resistance tensile strength, flash point and elongation, including analysis and interpretation of test results. Each report shall be properly identified. The test methods used shall be identified and the test results shall be recorded.

Certificates

Urethane Flooring System

Certificates indicating conformance with specified requirements and flooring manufacturers approval of the flooring applicator. Certificate

shall be accompanied by certified test reports from an approved laboratory showing that the resinous floor coating has been tested and meets the requirements specified.

Samples

Urethane Flooring System

Two 150 x 150 mm, (minimum) samples of each color of urethane flooring system.

1.3 QUALIFICATION OF APPLICATOR

Applicator shall be approved by the flooring manufacturer and shall have a minimum of 5 years experience in the application of the materials to be used.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers. Materials shall be kept in a clean, dry, area with temperatures controlled between 10 to 33 degrees C.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive urethane flooring shall have the slab and atmosphere maintained at a temperature above 10 degrees C for 2 days prior to installation and for 7 days following installation.

PART 2 PRODUCTS

2.1 NOT USED

2.2 CONDUCTIVE SPARKPROOF INDUSTRIAL URETHANE-BASED FLOORING

Conductive sparkproof industrial resin-based flooring system shall be trowel applied (3 mils/coat) in 2 coats over a 3 mil epoxy primer coat to a total thickness of 9 mils thick, conforming to ASTM C 722 with Type A surfacings (chemical resistance and moderate to heavy traffic resistance). Chemical resistance shall be as indicated.

2.3 CHEMICAL RESISTANCE

Urethane-based flooring shall be chemically resistant per ASTM D 1038 and ASTM C 722 to gasoline, skydrol, kerosene, isopropyl alcohol, toluene, hydrogen peroxide (50%) and hydrochloric acid (25%).

2.4 PRIMER

Primer shall be a material recommended by the polyurethane-based flooring manufacturer which will penetrate the pores of the substrate and bond with the topping to form a permanent monolithic bond between the substrate and the topping.

2.5 RESIN

Resin shall be suitable for the type application indicated.

2.6 FILLERS

Fillers, if required, shall be inert silica, quartz or other hard aggregate material as recommended by the flooring manufacturer. Fillers shall be furnished in the quantity necessary to impart the required color and physical characteristics. The filler shall contain sufficient fines to provide an even-textured, nonslip type of surface on the finished topping.

2.7 SEALER

Sealer shall be a product recommended by the flooring manufacturer. When applied to the topping and dry, it shall be nonslip and resistant to staining.

2.8 NOT USED

2.9 WALL BASE

2.9.1 NOT USED

2.9.2 Self-Coving

Self-coving shall consist of urethane-based flooring coved up at the base to the first horizontal mortar joint above the concrete floor. Coved base shall be the same thickness as the flooring.

2.10 COLOR

Color shall be as selected from manufacturer's standard colors.

PART 3 EXECUTION

3.1 PREPARATION OF CONCRETE SUBFLOOR

Installation of the floor topping shall not commence until the concrete substrate is at least 28 days old. The concrete surfaces shall be prepared in accordance with instructions of the manufacturer.

3.2 MIXING, PROPORTIONING, AND INSTALLING

Mixing, proportioning, and installing shall be in accordance with the approved instructions of the manufacturer.

3.3 TESTING

3.3.1 Electrical Resistance

Between 30 and 45 days after flooring installation is completed, and prior to its use, the flooring shall be tested in accordance with paragraph 12-4.1.3.8(b)(7) of NFPA 99. The resistance of the floor at any one location shall be more than 5,000 ohms in areas with 110 volts service, more than 10,000 ohms in areas with 220 volt service, and average less than 1,000,000 ohms and more than 25,000 ohms in all areas. Tests shall be made by a technician experienced in such work.

3.3.2 Spark Resistance

The floor shall be tested for spark resistance by stroking the floor vigorously with a 300 mm hardened steel file in a 914.4 mm arc. The test shall be performed for each 7.43 square meters of floor area. Tests shall

be made in a darkened space and only when the relative humidity of the atmosphere within the space does not exceed 50 percent. The floor shall not produce a spark when tested under these conditions.

3.4 PROTECTION

The resinous flooring shall be covered and protected from damage until completion of the work of all other trades.

-- End of Section --

SAFETY PAYS

Modular Design System

SECTION 09900

PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation and field application of paints and coatings.

1.2 RELATED SECTIONS

A. Section 05500 - Metal Fabrication: Shop primed items.

B. Section 15190 - Mechanical Identification.

C. Section 16195 - Electrical Identification.

1.3 REFERENCES

A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.

B. ASTM D2016 - Test Method for Moisture Content of Wood.

C. AWWA (American Water Works Association) - C204 - Chlorinated Rubber-Alkyd Paint Systems for the Exterior of Above Ground Steel Water Piping.

D. AWWA (American Water Works Association) - D102 - Painting Steel Water Storage Tanks.

E. NACE (National Association of Corrosion Engineers) - Industrial Maintenance Painting.

F. NPCA (National Paint and Coatings Association) - Guide to U.S. Government Paint Specifications.

G. PDCA (Painting and Decorating Contractors of America) - Painting - Architectural Specifications Manual.

H. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

1.4 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Product Data: Provide data on all finishing products.

B. Samples: Submit two samples, 300 mm x 300 mm in size illustrating selected colors for each color selected.

C. Manufacturer's Instructions: Indicate special surface preparation procedures, substrate conditions requiring special attention.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum four years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum six years documented experience approved by manufacturer.

1.7 FIELD SAMPLES

A. Provide field sample panel, 1 m x 1.5 m wide, illustrating special coating color, texture, and finish.

B. Locate where directed.

C. Accepted sample may not remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's

original, unopened packages and containers bearing manufacturer's name and label, and the following information:
Product name or title of material.
Product description (generic classification or binder type).
Manufacturer's stock number and date of manufacture.
Contents by volume, for pigment and vehicle constituents.
Thinning instructions.
Application instructions.
Color name and number

B. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

C. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height

at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers - Paint
   1. Devoe and Reynolds Co. (Devoe)
   2. The Glidden Company (Glidden)
   3. The Sherwin-Williams Company (S-W)

B. Manufacturers - Transparent Finishes
   1. Devoe
   2. Glidden
   3. S-W

C. Manufacturers - Stain
   1. Devoe
   2. Glidden
   3. S-W

D. Manufacturers - Primer Sealers
   1. Devoe
   2. Glidden
   3. S-W

E. Manufacturers - Block Filler
   1. Devoe
   2. Glidden
   3. S-W

2.2 MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint

thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

C. Patching Materials: Latex filler.

D. Fastener Head Cover Materials: Latex filler.

2.3 FINISHES

A. Refer to schedule at end of section for surface finish and color schedule.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D2016.
   4. Exterior Wood: 15 percent, measured in accordance with ASTM D2016.
   5. Concrete Floors: 8 percent.

3.2 PREPARATION

A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Correct defects and clean surfaces which affect work of this section.

C. Seal with shellac and seal marks which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.

G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

H. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

J. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

K. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals

with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

L. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

M. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

N. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

O. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

P. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied.

Q. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand wood and metal lightly between coats to achieve required finish.

F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

G. Allow applied coat to dry before next coat is applied.

H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Refer to Section 15190 and Section 16195 for schedule of color coding and identification banding of equipment, duct work, piping, and conduit.

B. Paint shop primed equipment.

C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are prefinished.

E. Paint interior surfaces of air ducts, that are visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, to match face panels.

F. Paint exposed conduit and electrical equipment occurring in finished areas.

G. Paint both sides and edges of plywood backboards for

electrical and telephone equipment before installing equipment.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.5 CLEANING

A. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.6 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

A. Metal Fabrications (Section 05500): Exposed surfaces of lintels.

3.7 SCHEDULE - EXTERIOR SURFACES

A. Pavement Markings:

1. Two coats of suitable paint, white or yellow as required.

B. Concrete, Concrete Block, Cement Plaster:

1. One coat of primer sealer latex.
2. Two coats of latex semi-gloss.

C. Steel - Unprimed:
1. One coat of alkyd primer.
2. Two coats of alkyd enamel, semi-gloss.

D. Steel - Shop Primed:
1. Touch-up with zinc chromate primer.
2. Two coats of alkyd enamel, semi-gloss.

E. Steel - Galvanized:
1. One coat galvanize primer.
2. Two coats of alkyd enamel, semi-gloss.

F. Aluminum - Mill Finish:
1. One coat etching primer.

2. Two coats of alkyd enamel, semi-gloss.

3.8 SCHEDULE - INTERIOR SURFACES

A. Wood - Painted:

1. One coat of alkyd prime sealer.
2. Two coats of alkyd enamel, semi-gloss.

B. Concrete, Concrete Block, Cement Plaster:

1. One coat of primer sealer latex.
2. Two coats of latex semi-gloss.

C. Steel - Unprimed:

1. One coat of alkyd primer.
2. Two coats of alkyd enamel, semi-gloss.

D. Steel - Primed:

1. Touch-up with alkyd primer.
2. Two coats of alkyd enamel, semi-gloss.

E. Steel - Galvanized:

1. One coat galvanize primer.
2. Two coats of alkyd enamel, semi-gloss.

F. Concrete Floors: Other than hangar bay floors.

1. One coat of alkali resistant primer.
2. Two coats of alkyd floor enamel, gloss.

G. Gypsum Board:

1. One coat of alkyd primer sealer.
2. Two coats of latex, eggshell.

H. Wall Surfaces Under Vinyl Wall Covering:

Modular Design System

1. One coat of alkyd primer sealer.

I. Insulated Coverings - Canvas and Cotton:

1. One coat of alkyd primer sealer.
2. Two coats of alkyd enamel, eggshell.

J. Locker Rooms:

1. Walls behind lockers shall be painted. See gypsum board.

END OF SECTION

SECTION 10105

VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surfaced metal chalkboards.

B. Surfaced metal markerboards.

C. Map and display rail.

D. Trim, Chalkrail, and accessories.

1.2 RELATED SECTIONS

A. Section 09260 - Gypsum Board Systems: Substrate construction.

B. Section 06114 - Wood Blocking and Curbing: Wood grounds.

C. Section 04311 - Concrete Masonry Units: Substrate construction.

1.3 REFERENCES

A. AHA A135.4 - Basic Hardboard.

B. ASTM A424 - Steel Sheets for Porcelain Enameling.

C. ASTM A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

D. ASTM B209 - Aluminum-Alloy Sheet and Plate.

E. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

F. ASTM C36 - Gypsum Wallboard.

G. ASTM C208 - Insulation Board (Cellulose Fiber) Structural and Decorative.

H. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

I. FS CCC-W-408 - Wall Covering, Vinyl-Coated.

J. FS L-P-1040 - Plastic Sheets and Strips, Polyvinyl Floride.

K. HPMA HP - Hardwood and Decorative Plywood.

L. NPA A208.1 - Mat Formed Wood Particleboard.

M. PEI (Porcelain Enamel Institute) - Performance Specifications for Porcelain Enamel Chalkboards.

N. PS 1 - Construction and Industrial Plywood.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate wall elevations, dimensions, joint locations.

B. Product Data: Provide data on markerboards, map and display rail, trim and accessories.

C. Samples: Submit two samples 152 x 152 mm in size illustrating materials and finish, color of markerboard and trim.

1.5 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include data on regular cleaning, and stain removal.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

Modular Design System

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.8 WARRANTY

A. Warranty: Include coverage of markerboard surface from discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Claridge Products and Equipment, Inc. Product: LCS Writing System

B. Greensteel, 29 S. Laring Ave., Dixonville, PA Product: Dry Markerboard

C. Carolina Chalkboard, Landis, N.C. Product: Vitrasteel Dry Markerboard

2.2 MARKERBOARD MATERIAL

A. Sheet Steel: ASTM A526, galvanized to G90 designation.

2.3 CORE AND FRAME MATERIALS

A. Plywood: APA Structural I, Grade C-D birch species.

B. Foil Backing: Aluminum sheet, 0.38 mm thick.

C. Frame and Chalkrail: Aluminum extrusions, ASTM B221, 6061 alloy, temper.

2.4 ACCESSORIES

A. Adhesives: Type used by manufacturer.

B. Map Supports: Formed aluminum sliding hooks, to fit map rail.

C. Temporary Protective Cover: Sheet polyethylene, 0.2 mm thick.

D. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.

2.5 FABRICATION - MARKERBOARDS

Modular Design System

A. Outer Face Sheet: Steel, 0.6 mm thick.

B. Core: Plywood, 13 mm thick.

C. Backing Surface: Aluminum sheet, 0.4 mm thick.

D. Splice Joint: Concealed spline of sheet steel.

2.6 FABRICATION - DISPLAY RAIL (NO. 51 MAP AND DISPLAY RAIL)

A. Heavy gauge extruded aluminum with insert of 6 mm thick. Provided with No. 51M display hook and map rail ends.

2.7 FABRICATION - FRAME AND TRIM

A. Aluminum Frame: Of straight profile; exposed fasteners, map rail with cork insert separate of markerboard and surfaces.

B. Aluminum Chalkrail: Of No. 263 profile, one piece full length of markerboard, open ends; exposed fasteners.

2.8 FINISHES

A. Porcelain Enamel: Glass fibered enamel, baked to vitreous surfaces; Porcelain Enamel Institute Type A; White color.

B. Cork Surface: Natural light brown cork.

C. Aluminum Frame, Chalkrail, and Accessories: Mill finish natural aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

B. Verify flat wall surface for frameless adhesive applied type.

3.2 INSTALLATION

Modular Design System

A. Install markerboards and map and display rail, in accordance with manufacturer's instructions.

B. Establish bottom of perimeter frame above finished floor by indications on drawings.

C. Secure units level and plumb.

D. Markerboards: Butt panels tight with concealed spline to hairline joint.

3.3 CLEANING

A. Clean markerboard surfaces in accordance with manufacturer's instructions.

B. Cover markerboard surfaces with protective cover, taped to frame.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 10160

METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal toilet compartments, floor mounted head rail braced.

B. Urinal screens; wall mounted.

1.2 RELATED SECTIONS

A. Section 09260 - Gypsum Board System: Framing and plates within walls.

B. Section 10800 - Toilet and Bath Accessories.

1.3 REFERENCES

A. ANSI A117.1 - Safety Standards for the Handicapped.

B. ASTM A167 - Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

C. ASTM A424 - Steel Sheet for Porcelain Enameling.

D. ASTM A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

E. FS RR-P-1352 - Partitions, Toilet, Complete.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Samples: Submit two samples of partition panel sheet, 300 mm x 300 mm in size illustrating panel finish, color, and sheen.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI A117.1 code for access for the handicapped.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.7 COORDINATION

A. Coordinate the work with placement of support framing and anchors in wall and ceiling.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Global Steel Products Corp.

B. Monarch Toilet Partitions, Inc.

C. Sanymetal Products Co.

2.2 MATERIALS

A. Steel Sheet: ASTM A526, with G90 zinc coating.

2.3 ACCESSORIES

A. Pilaster Shoe: Formed chromed steel with satin finish, ASTM A167 type 304 stainless steel with No. 4 finish, 75 mm high, with adjustable screw jack.

B. Head Rails: Hollow steel tube, 25 x 41 mm size, with anti-grip strips and cast socket wall brackets.

C. Attachments, Screws, and Bolts: Stainless steel; tamper proof type, heavy duty extruded aluminum brackets.

D. Hardware: Stainless steel:
   1. Pivot hinges, gravity type, adjustable for door close positioning.
   2. Nylon bearings.
   3. Thumb turn door latch with exterior emergency access feature.
   4. Door strike and keeper with rubber bumper.
   5. Coat hook with rubber bumper.
   6. Door pull for outswinging doors.

2.4 FABRICATION

A. Fabricate partitions in accordance with FS RR-P-1352.

B. Fabricate components of steel sheet as follows:
   1. Panel and Door Faces: 20 gage.
   2. Pilaster Faces: 18 gage.
   3. Reinforcement: 12 gage.

C. Doors and Panels:
   1. Thickness: 25 mm.
   2. Door Width: 600 mm.
   3. Door Width for Handicapped Use: 915 mm, out-swinging.
   4. Height: 1475 mm.

D. Pilasters: 32 mm thick, of sizes required to suit cubicle width and spacing.

E. Door, Panel, and Pilaster Construction: Sheet steel face, pressure bonded to sound deadening core, form and close edges, miter and weld corners, grind smooth.

F. Internal Reinforcement: Provide in areas of attached hardware and fittings. Mark locations of reinforcement for partition mounted washroom accessories.

2.5 FINISHING

A. Clean, degrease, and neutralize panels.

B. Follow immediately with a phosphatizing treatment, prime coat

and two finish coats baked enamel.

C. Single Color: Color as selected from manufacturer's, standard colors.

D. Stainless Steel Surfaces: No. 4 finish.

E. Exposed Steel Surfaces: Satin stainless.

F. Non-ferrous Surfaces: Satin chrome plated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 9 mm to 12 mm space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets with tamper proof through bolts and nuts. Locate head rail joints at pilaster center lines.

E. Install 760 mm wide x 1060 mm high stainless steel protective splash panels on partitions adjacent to urinals. Fasten with stainless steel screws spaced 8 inches on center at perimeter.

F. Anchor urinal screen panels to walls with continuous panel brackets attached at 200 mm o.c. maximum.

G. Support pilasters from built-in framing using two adjustable hanging studs providing vertical leveling. Conceal ceiling fastenings with pilaster shoe.

H. Equip each door with two hinges, one door latch, one coat hook and bumper.

I. Install door strike and keeper with door bumper on each pilaster in alignment with door latch.

J. Field touch-up of scratches or damaged enamel finish will not be permitted.

K. Replace damaged or scratched materials with new materials.

3.3 ERECTION TOLERANCES

A. Maximum Variation From True Position: 6 mm.

B. Maximum Variation From Plumb: 3 mm.

3.4 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 5 mm.

B. Adjust hinges to position doors in partial opening position when unlatched.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10211

METAL WALL LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fixed and operable louvers and frames.

B. Insect and bird screening.

1.2 RELATED SECTIONS

A. Section 04200 - Masonry.

B. Section 07900 - Joint Sealers.

C. Section 15890 - Ductwork: Ductwork attachment to louver.

1.3 REFERENCES

A. AMCA 500 (Air Movement Control Association) - Test Method for Louvers, Dampers, and Shutters.

B. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate.

C. ASTM A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

D. ASTM A527 - Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.

E. ASTM B209 - Aluminum-Alloy Sheet and Plate.

F. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

1.4 PERFORMANCE REQUIREMENTS

Modular Design System

A. Louver: To permit passage of air at a face velocity of 400 ft / min without blade vibration or noise, with maximum static pressure loss of 0.15 inches.

B. Louver: To permit 50 percent free area.

1.5 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. Samples: Submit two samples 300 mm x 300 mm in size illustrating finish and color of exterior and interior surfaces.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AMCA Certification for intake and exhaust louvers.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.8 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

Modular Design System

A. Coordinate the Work with installation of masonry and flashings.

1.10 WARRANTY

A. Provide twenty year warranty under provisions of Section 01700.

B. Warranty: Include coverage for degradation of polyvinylidene fluoride.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A.	The Airolite Company	Product Model K8206, K6776.
B.	Arrow United Industries	Product Model EA-680-D, EA-625-DD
C.	Construction Specialties, Inc.	Product Model A6097, 6967.

2.2 MATERIALS

A. Aluminum: ASTM B221, 6063-T5 alloy, temper; extruded shape; prefinished with shop applied flouropolymer finish.

2.3 SCREENS

A. Insect Screen: 12 mm meash x 1.60 mm diameter aluminum bird screen in a rewirable extruded aluminum frame.

2.4 ACCESSORIES

A. Fasteners and Anchors: Stainless steel type.

B. Flashings: Of same material as louver frame. Formed or extruded aluminum.

C. Sealants: Exterior type specified in Section 07900.

2.5 FABRICATION

A. Louver Panel Thickness: 152 mm deep, face measurements as indicated.

B. Louver Blade Design: Sloped at 30 degrees for operable, 45 degrees for fixed blade; reinforced with intermediate stiffeners, material thickness of 2.06 mm minimum, integral and lateral rain water stops positioned on blade.

C. Louver Frame: Channel shape, welded corner joints, material

thickness of 2.06 mm minimum.

D. Intermediate Mullions: Recessed of extruded aluminum, profiled to suit louver frame.

E. Head and Sill Flashings: Extruded to required shape, single length in one piece per location.

F. Screens: Install screen mesh in shaped frame, reinforce corner construction, shop install to louver with fasteners.

2.6 FINISHES

A. Exterior and Interior Aluminum Surfaces, Screen. Prepainted finish of flouropolymer color as selected from manufacturers standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

D. Secure louvers in opening framing with concealed fasteners.

E. Install screen and frame to interior side of louver.

F. Install screen and frame to intake louvers.

G. Install perimeter sealant and backing rod in accordance with Section 07900.

3.3 CLEANING

A. Strip protective finish coverings.

B. Clean surfaces and components.

END OF SECTION

SECTION 10440

INTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1980) Designation System for Aluminum Finishes
AA PK-1	(1989) Registration Record of Aluminum Association Alloy Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot
AA SAA-46	(1978) Standards for Anodized Architectural Aluminum

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 605.2	(1992; Addenda Jan 1995) Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; Rev 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM C 1036	(1991) Flat Glass

1.2 GENERAL

Interior signage shall be of the sizes and types shown on the drawings, shall conform to the requirements specified herein, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Signs shall be the standard product of a manufacturer regularly engaged in

the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Data

Interior Signage

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Drawings

Interior Signage; Cast Plaque Signs; Exterior Monument Type Sign

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location of each sign type shall be included.

SD-14 Samples

Interior Signage; Cast Plaque Signs

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

a. Door sign.

b. Building directory.

c. Cast plaque sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area.

1.5 EXTRA STOCK

Submit prepaid coupon books for use by Owner for 100 each message strips for Window Sign Inserts.

a. Provide computer generated coupon books complete with Owner's name, address, message strip background color, type style, and type code imprinted on each coupon.

b. Provide completed message strip return to Owner from coupon book order within ten working days of receipt of coupon by manufacturer.

PART 2 PRODUCTS

2.1 COLOR, FINISH, AND CONTRAST

Color shall be as indicated in schedule. In buildings required to be handicapped-accessible, the characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

2.2 CHARACTER PROPORTIONS AND HEIGHTS

Letters and numbers on signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter X. Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 75 mm.

2.3 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least 3 mm thick, and aluminum plate or sheet shall be at least 1.3 mm thick. Extrusions shall conform to ASTM B 221; plate and sheet shall conform to ASTM B 209. Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown and shall conform to AA SAA-46.

2.3.1 Anodic Coating

Anodized finish shall conform to AA DAF-45 as follows:

a. Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.010 mm or thicker.

b. Integral color anodized designation AA-M10-C22-A32, Architectural Class 0.010 to 0.018 mm .

c. Electrolytically deposited color-anodized designation AA-M10-C22-A34, Architectural Class II 0.010 to 0.018 mm .

2.3.2 Organic Coating

Organic coating shall conform to AAMA 605.2, with total dry film thickness not less than 0.030 mm.

2.4 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting for graphics shall be a minimum 0.08 mm film thickness. Film shall include a precoated pressure sensitive adhesive backing.

2.5 ACRYLIC SHEET

Acrylic sheet for panels and components shall conform to ANSI Z97.1.

2.6 PLAQUE SIGNS

Plaque signs shall be a modular type signage system. Signs shall be fabricated of acrylic plastic conforming to ANSI Z97.1.

2.6.1 Standard Modular Plaque Signs

Plaque signs shall consist of gloss finish acrylic plastic, thickness and size as shown. Frames shall be molded acrylic. Corners of signs shall be squared.

2.6.2 Modular Changeable Message Strip Plaque Signs

Changeable message strip plaque signs shall consist of cast acrylic back laminated to matte finish laminated thermosetting Type ES plastic face with message slots, as detailed, for insertion of changeable message strips. Thickness and size of signs shall be as shown on the drawings. Individual 1.6 mm thick message strips to permit removal, change, and reinsertion shall be provided as detailed. Corners of signs shall be squared.

2.6.3 Type of Mounting For Plaque Signs

Mounting for framed, hanging, and projecting signs shall be by holes and screws. Surface mounted signs shall be provided with countersunk mounting holes in plaques and mounting screws.

2.7 GRAPHICS

2.7.1 Raised and Brailled Characters and Pictorial Symbol S

Letters and numbers on signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 0.8 mm upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 16 mm height, but no higher than 50 mm. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 152 mm minimum in height. Accessible facilities shall use the international

2.7.2 Graphics Application

Signage graphics shall conform to the following:

a. Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. No handcut screens will be accepted. Original art shall be defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.

b. Message shall be acrylic letters 3 mm thick and chemically welded to 3.2 mm thick acrylic backup sheet.

c. Tactile characters and symbols shall be raised 0.8 mm minimum from the sign face. Signs shall be of one piece construction. Add-on characters are not acceptable.

2.7.3 Messages

See drawings and schedule for message content, Typeface: Helvetica medium. Type size 12.7 mm.

2.8 CHANGEABLE LETTER BUILDING DIRECTORIES

2.8.1 Changeable Letter Directories

Changeable letter building directories shall be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. The changeable directory board shall be 800 mm high and have a width in 900 mm increments, and shall have a 150 mm high continuous header. Width of sign shall be as shown on the drawings. Colors shall be white letters and numbers on a black felt grooved background. Message content shall be as shown on schedule.

2.8.1.1 Header Lettering

Building or military unit name letters shall be upper case Helvetica Medium 50 mm high letter, center justification.

2.8.1.2 Changeable Directory Letters

Changeable letters shall be upper and lower case Helvetica Medium. Tabbed vinyl letters and numbers shall be furnished in accordance with the drawings and schedule.

2.8.1.3 Header Panel

Header panel shall be acrylic with raised acrylic letters.

2.8.1.4 Doors

2.8.1.5 Door Glazing

Door glazing shall be in accordance with ASTM C 1036, Type 1, Class 1, Quality 3, minimum 3 mm thick.

2.8.1.6 Door Construction

Extruded aluminum door frame shall be of same finish as surrounding frame. Corners shall be mitered and assembled with concealed fasteners. Hinges shall be standard with the manufacturer, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.8.1.7 Door Locks

Door locks shall be manufacturer's standard, and shall be keyed alike. Lock finish shall match the door finish.

2.8.1.8 Fabrication

Extruded aluminum frames and trim shall be assembled with corners reinforced and mitered to a hairline fit, with no exposed fasteners. Removable changeable directory panel shall consist of plywood back with wool felt covering backgrooved 6 mm on centers to receive flanged letters.

2.9 CAST PLAQUE SIGNS

Cast plaque signs shall be provided as indicated on the drawings. Exterior plaque sign shall be from cast aluminum. Interior plaque sign shall be from cast bronze. Signs shall be government furnished, contractor installed. Signs are 775 mm diameter.

Contractor shall obtain "Minute Man" plaque signs from the Baltimore District U.S. Army Corps of Engineers. The point of contact for obtaining plaque signs is:

U.S. Army Corps of Engineers
Baltimore District
ATTN: CENAB-PP-M (Jim Payne)
P.O. Box 1715
Baltimore, MD 21201
(410) 962-4395

2.9.1 Mounting for Plaque Signs

For exterior cast aluminum plaque signs mounting shall be concealed, secured to brick face in location as indicated on the drawings. For interior cast bronze sign mounting shall be by invisible frame method with concealed angle clips and machine screws. Contractor shall coordinate location of indoor sign with other panels, fixtures, devices, etc. which are located adjacent to sign. Mounting height shall be coordinated with Contracting Officer.

2.10 MONUMENT TYPE SIGN

Base-mounted panel type sign with sign copy on two sides. Panel sizes shall be as indicated on the drawings.

2.10.1 Sign Panels

Sign panels shall be fabricated from aluminum sheet (3.175 mm) minimum thickness; integrated with aluminum frame extrusions (3.175 mm) 300 mm wide for a flush appearance. Panel mounting to aluminum frame extrusions shall be concealed with fasteners compatible with sign materials and as recommended by sign manufacturer.

2.10.2 Base

Sign base shall be constructed from masonry and cast-in-place concrete as indicated on the drawings. Internal sign panel frame member shall be secured to aluminum skirt cast in to concrete base with stainless steel anchors at 600 mm centers.

2.10.3 Sign Letters

Letters shall be cast aluminum dimensional, 25 mm deep and stand uniformly 25 mm off face of signboard. All pin connectors, spacers, and fasteners shall be aluminum or compatible to avoid corrosion. Copy shall be as indicated on the drawings.

2.11 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Anchorage system shall be of the type recommended by the manufacturer of the indicated substrate. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 2 mm thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 0.13 mm green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage

manufacturer's recommendations.

2.12 FABRICATION AND MANUFACTURE

2.12.1 Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.12.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting height shall be as indicated on the drawings. Mounting location for such signage shall be so that a person may approach within 75 mm of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

SECTION 10508

METAL WARDROBE LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Locker units with hinged doors.

B. Metal tops, and filler panels.

C. Locker benches.

1.2 RELATED SECTIONS

A. Section 06114 - Wood Blocking and Curbing: Wood grounds and attachment strips.

1.3 REFERENCES

A. ASTM A446/A446M - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

B. ASTM A526/A526M - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

1.4 SUBMITTALS: Section 01300 - Submittals: Procedures for submittals.

A. Product Data: Provide data on locker types, sizes and accessories.

B. Shop Drawings: Indicate locker plan layout, numbering plan and key codes.

C. Samples: Submit two samples 75 x 150 mm in size, of each color selected; applied to specified base metal.

1.5 DELIVERY, STORAGE, AND PROTECTION

Modular Design System

A. Transport, handle, store, and protect products.

B. Protect locker finish and adjacent surfaces from damage.

Modular Design System

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The Interior Medart Inc.
P. O. Box 658, Greenwood, MS 38930
Phone (800)647-7155

B. List Industries, Inc. 401 N.W. 12th Ave.
Deerfield Beach, FL 33442
Phone (305) 429-9155

C. Republic Storage System Co., Inc.
1038 Belden Ave., N.E., Canton, Ohio 44705
Phone (800) 447-1255

2.2 MATERIALS

A. Sheet Steel: ASTM A446 Grade D, ASTM A526 Coating Designation G90, stretcher leveled; to the following minimum thicknesses:

1.	Body and Shelf:	24 gage (0.6 mm)
2.	Door Outer Face:	16 gage (1.2 mm)
3.	Door Inner Face:	20 gage (0.9 mm)
4.	Door Frame:	16 gage (1.5 mm)
5.	Hinges:	14 gage (1.9 mm)
6.	Base:	20 gage (0.9 mm)
7.	Sloping Top:	20 gage (0.9 mm)
8.	Trim:	20 gage (0.9 mm)

Single and Double Tier Lockers

B. Locker size as indicated on the drawings with dust covers around the base perimeter. Dust covers with sloped tops and end covers to preclude dust accumulation. End panels as required. Maximum size of grouping units is three lockers per unit (one single tier, two double tier lockers). Latch hook to have bevel on front upper edge to allow latch clip to ride up slope as door closes. Steel door frames of minimum 16 gauge metal with three hinges of minimum 14 gauge steel.

Vertical members shall have an additional flange to form continuous door strike. Minimum gauge for top, bottom, shelves, sides, back and row ends if 20 gauge steel. Eyelet for padlock must accept a 8 mm padlock shank, providing a secured locking three point latching mechanism. Lockers will be sequentially numbered with a plate beginning with #1. Locker will contain a single shelf at top with hanging rod and wall hooks on both sides. Louvers for circulation both at top and bottom.

C. ALSE Double Tier Locker: Size: 460 mm x 460 mm deep x 1520 mm high with 150 mm high base and cover. Recess trim to be provided around sides and top of lockers. Trim to be same color as lockers. Maximum size of grouping unit is three lockers per unit. Latch hook to have bevel on front upper edge to allow latch clip to ride up slope as door closes. Steel door frame of minimum 16 gauge metal with two hinges of minimum 14 gauge steel. Vertical members shall have an additional flange to form continuous door strike. Minimum gauge for top and bottom is 20 gauge steel. All sides and fronts to be constructed of 14 gauge diamond perforated panels to allow for maximum ventilation. Lockers are to be stocked and supplied from the backside. Lockers should have no back panel but be supplied with 16 gauge metal frame for stability. Eyelet for padlock must accept a 8 mm padlock shank.

2.3 ACCESSORIES

A. For Each All Metal, Quiet Type Wardrobe Locker: Two double prong wall hooks, coat hanger bar, rubber bumper.

B. Locker Benches: Stationary Free standing type; bench top of laminated maple species wood, stained, sealed and varnished; pedestals of chrome steel 444.5 mm high.

2.4 FABRICATION

A. Locker Units:
Configuration and size as previously indicated.
Mounting: Surface mounted.

Modular Design System

Base:	Metal base.
Base Height:	100 mm.
Top:	Sloped metal with closures.
Locking:	Equipped for built-in with master key cylinder locks.
Ventilation Method:	Louvered top and bottom frame and top and bottom of door.
Class	Quiet

B. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.

C. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.

D. Doors: Hollow channel construction, 30 mm thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.

E. Hinges: Two for doors under 1 050 mm high; three for doors over 1 050 mm high; weld securely to locker body and door.

F. Integral Cylinder Lock: Five (5) pin type, master keyed; provide two keys per lock and four master keys.

G. Number Plates: Provide oval shaped aluminum plates. Form numbers 12.7 mm high of block font style, in contrasting color.

H. Provide ventilation openings at top and bottom of each locker.

I. Form recess for operating handle and locking device.

J. Finish edges smooth without burrs.

K. Fabricate sloped metal tops, ends and closure pieces.

L. Provide perforated end panels and filler strips.

M. Fabricate 100 mm high steel bases with end closures.

2.5 FINISHES

A. Clean, degrease, and neutralize metal; prime and finish with two coats of baked enamel.

B. Color: As scheduled on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and embedded anchors are properly sized.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lockers plumb and square.

C. Secure lockers with anchor devices to suit substrate materials at floor and/or wall. Minimum Pullout Force: 445 N.

D. Bolt adjoining locker units together to provide rigid installation.

E. Install end panels, filler panels, sloped tops, and bases.

F. Install accessories.

G. Replace components that do not operate smoothly.

H. Install benches with anchor devices to suite substrate material with minimum pullout force 445 N.

3.3 CLEANING

A. Cleaning installed work.

B. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers and cabinets.

B. Accessories.

1.2 RELATED SECTIONS

A. Section 06114 - Wood Blocking and Curbing: Wood blocking and shims.

B. Section 09260 - Gypsum board System: Roughed-in wall openings.

C. Section 09900 - Painting: Field paint finish.

1.3 REFERENCES

A. ANSI/NFPA 10 - Portable Fire Extinguishers.

B. ANSI/UL 711 - Rating and Fire Testing of Fire Extinguishers.

C. UL 8 - Foam Fire Extinguishers.

D. UL 154 - Carbon Dioxide Fire Extinguishers.

E. UL 299 - Dry Chemical Fire Extinguishers.

F. UL 626 - 2 1/2 Gallon Stored Pressure, Water Type Fire Extinguishers.

G. UL 1093 - Halogenated Agent Fire Extinguishers.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

Modular Design System

A. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, and location.

B. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.

C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.6 QUALITY ASSURANCE

A. Provide units conforming with ANSI/UL 711.

1.7 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 10 for requirements for extinguishers.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. J. L. Industries, 4450 W. 78th St. Circle
Bloomington, MN 55435, phone 612-835-6850
product: Fire Extinguisher and Cabinets

B. Larsen's Manufacturing Company
7421 Commerce Lane N.E.
Minneapolis, MN 800-527-7367

Modular Design System

Product: Fire Extinguisher and Cabinets

C. Potler-Roemer, 16833 Edwards Rd.,
Cerritos, CA 90701-2417
310-404-3753
Product: Fire Extinguisher and Cabinets

2.2 CABINETS

A. Metal: Stainless steel with #4 stainless steel finish; 18 gage (1.2 mm) thick base metal.

B. Configuration: Semi-recessed type with 102 mm projection (max.) from wall. Dimensions as follows (min.):

1. Frame O.D.: 368 mm x 750 mm.
2. Tub I.D: 305 mm x 685 mm x 203 mm.
3. Wall Opening: 330 mm x 710 mm x 105 mm.

C. Trim Type: 31.75 mm face trim on frame and door.

D. Door: 18 gage (1.2 mm) thick, reinforced for flatness and rigidity; full glass style.

E. Door Glazing: Glass, clear, 3 mm thick float tempered.

F. Cabinet Mounting Hardware: Appropriate to cabinet.

G. Provide rated fire extinguisher cabinets where installed in rated walls.

2.3 ACCESSORIES

A. Extinguisher Brackets: Formed steel, white enamel finish.

B. Cabinet Signage: "Fire Extinguishers" in black letters, vertical orientation.

2.4 FABRICATION

A. Form cabinet enclosure with right angle inside corners and

seams. Form perimeter trim and door stiles.

B. Pre-drill for anchors.

C. Hinge doors for 180 degree opening with continuous piano hinge. Provide nylon roller type catch.

D. Weld, fill, and grind components smooth.

2.5 FINISHES

A. Cabinet Exterior Trim and Door: #4 stainless steel finish.

B. Cabinet Interior: #4 stainless steel finish.

2.6 FIRE EXTINGUISHERS

Extinguishers are to be provided by the user. Contractor will coordinate with the Contracting Officer to ensure cabinet size is sufficiently sized to accommodate user supplied extinguishers. Locations as indicated on the drawings are based on travel distances and may not be adjusted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and to comply with ADA reach ranges (Section 4.2) and protruding objects (Section 4.4) criteria.

B. Install cabinets plumb and level in wall openings, located from finished floor as indicated on the architectural drawing.

C. Secure rigidly in place.

D. Position cabinet signage on door to cabinets.

END OF SECTION

SECTION 10605

WIRE MESH PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wire mesh system for walls and ceiling.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete.

B. Section 09900 - Painting.

1.3 REFERENCES

A. ASTM A36 - Structural Steel.

B. ASTM A123 - Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.

C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.

E. ASTM A446 - Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical Quality).

F. ASTM A500 - Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

G. ASTM A501 - Hot-formed Welded and Seamless Carbon Steel Structural Tubing.

H. ASTM A510 - General Requirements For Wire Rods and Course Round Wire, Carbon Steel.

I. ASTM A580 - Stainless and Heat-Resisting Steel Wire.

J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

K. ASTM B211 - Aluminum-Alloy Bars, Rods, and Wire.

L. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

M. AWS D1.1 - Structural Welding Code.

N. SSPC (Steel Structures Painting Council) - Painting Manual.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, framed openings, anchorage, welds, type and location of fasteners, and accessories or items required of related work.

B. Product Data: Provide data for screen materials, finishes, and hardware.

C. Samples: Submit two samples, 300 mm x 300 mm in size illustrating screen material. Submit samples of hinge latchset illustrating style, color, and finish.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
Acorn Wire and Iron Works, Inc.
The G-S Company
Hoosier Fence Co., Inc.
Indiana Wire Products, Inc.
Kentucky Metal Products Co.
King Wire Partitions Inc.
Lakeside Wire and Iron Co.
Miller wire Works, Inc.
Wire and Iron Products, Inc.

2.2 HEAVY DUTY MESH PARTITIONS

A. Mesh: 10-gage crimped steel wire woven into 38 mm diamond mesh, securely clinched to frame members.

B. Frames: Provide cutouts for pipes, ducts, beams, and other items shown or necessary for partition installation. Finish edges of cutouts to provide a neat, protective edge.

C. Frame Members: 30 mm by 15 mm cold rolled steel channels, conforming to ASTM A36, with 10 mm bolt holes approximately 450 mm o.c.

1. Horizontal Reinforcing Members: 38 mm by 20 mm by 3 mm cold rolled steel channel with wire woven through, or two 25 mm by 12 mm channels bolted or riveted toe-to-toe through the mesh and secured to vertical members. Provide number of horizontal reinforcing members to suit panel height as recommended by partition manufacturer.

D. Stiffening Bars: Provide flat bar stiffener posts between all abutting panel frames. Size as recommended by partition manufacturer for partition height required. Increase size of

stiffening bars if required to maintain partition rigidity.

E. Top Capping Bars: 75 mm by 4.1 pound channel secured to top framing members with 6 mm "U" bolts spaced not more than 710 mm o.c.

F. Corner Posts: 50 mm by 50 mm by 3 mm angles with floor shoe and 10 mm bolt holes to align with bolt holes in vertical frame members.

G. Line Posts: Where partition runs exceed 6100 mm without intersection or connection to overhead framing, furnish 75 mm by 4.1 pound channel line posts with 125 mm by 450 mm by 6 mm base plates located at recommended intervals to ensure partition rigidity and stability.

H. Intersection Posts: Wherever 3- or 4-way intersections occur, use 50 mm by 50 mm tubular steel post with floor shoe and 10 mm bolt holes aligned for bolting to adjacent panels.

1. For other than 90 degree intersections, use manufacturer's recommended tubular corner posts and installation accessories.

I. Floor Shoes: Cast metal, sized to suit vertical framing and to provide approximately 75 mm clear space between finished floor and bottom horizontal frame members. Furnish units with set screw for leveling adjustment.

2.3 DOORS

A. Sliding Door: Door frame of 38 mm by 20 mm by 3 mm channel with 38 mm by 38 mm flat bar cover plate on all 4 sides. Provide door with two 4-wheel roller bearing carriers, box track, bottom guide channel and mortise-type cylinder lock operated by key outside and recessed knob inside. Align bottom of door with bottom of adjacent panels.

B. Hinged Door: Door frame of 38 mm x 20 mm channel with 38 mm x 3 mm flat bar cover three sides. 20 mm x 22 mm x 3 mm angle riveted to lock side. Each door shall have 1-1/2 pairs

heavy butt hinges riveted to both door and hinge bar. Mortise type cylinder locks operated by key outside, recessed knob inside.

C. Provide manufacturer's standard cylinders for lock.

D. Cylinders for locks are specified in Division 8.

2.4 WINDOW GUARDS

A. Horizontal Reinforcing Members: Two 25 mm by 10 mm channels riveted toe-to-toe through the mesh and welded to vertical members. Provide number of horizontal reinforcing members to suit panel height as recommended by partition manufacturer.

B. Anchorage Devices: Furnish appropriate types and quantities of anchorage devices to provide adequate anchorage to adjacent structures.

2.5 FABRICATION

A. Do not use components less than sizes indicated. Use larger size components as recommended by partition component manufacturer.

B. Provide bolts, hardware, and accessories for complete installation.

C. Finish: Manufacturer's standard shop-applied enamel finish. Provide manufacturer's standard finish color.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION

A. Erect partitions plumb, rigid, properly aligned, and securely fastened in place, complying with drawings and manufacturer's recommendations.

B. Provide additional field bracing as shown or necessary for rigid, secure installation. Erector to provide additional clips and bracing as required.

C. Installation: All bolts shall be welded or peened to eliminate removal of nuts.

3.3 ADJUST AND CLEAN

A. Adjust moving components for smooth operation without binding.

B. Touch-up damaged finish after completion of installation using field-applied paint to match color of shop-applied finish.

END OF SECTION

SECTION 10800

TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Toilet, bath shower and washroom accessories.

B. Grab bars.

C. Attachment hardware.

1.2 RELATED SECTION

A. Section 09111 - Metal Stud Framing System: In wall framing and plates for support of accessories.

B. Section 10160 - Metal Toilet Compartments.

1.3 REFERENCES

A. ANSI A117.1 - Safety Standards for the Handicapped.

B. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

E. ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.

F. ASTM B456 - Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

G. NEMA LD-3 - High Pressure Decorative Laminates.

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

B. Samples: Submit two samples of each component, illustrating color and finish.

C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and anchorage.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI A117.1 code for access for the handicapped.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on product data.

1.7 COORDINATION

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bobrick Washroom Equipment, Inc. Product Bobrick

B. Bradley Corporation Product Bradley

C. American Specialties

2.2 MATERIALS

A. Sheet Steel: ASTM A366.

B. Stainless Steel Sheet: ASTM A167, Type 304.

C. Tubing: ASTM A269, stainless steel.

D. Adhesive: Two component epoxy type waterproof.

E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, and security type.

F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FABRICATION

A. Weld and grind joints of fabricated components, smooth.

B. Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.

C. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with 38 mm clear of wall surface.

D. Shop assemble components and package complete with anchors and fittings.

E. Provide steel anchor plates, adapters, and anchor components for installation.

2.4 KEYING

A. Master key all accessories.

2.5 FINISHES

A. Galvanizing: ASTM A123 to 380 g/sq m. Galvanize ferrous metal and fastening devices.

B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

C. Stainless Steel: No. 4 satin luster finish.

D. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify exact location of accessories for installation.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

Modular Design System

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions and suggested mounting heights and ANSI A117.1.

B. Install plumb and level, securely and rigidly anchored to substrate.

3.4 SCHEDULE

A. AC-1, Mop and Broom Holder, (ASI Model 1318, Bradley Model 9986 Bobrick Model B-224) - Strip shall be constructed of 16 gauge Type 302 (18-8) stainless steel no. 4 satin finish. Strip shall be formed with a return flange to the wall on top and a returned flange to the wall at the bottom. Holder pieces shall be constructed from molded resilient rubber with ribbed gripping surface. Strip shall be 1220 mm long with 6 holders.

B. AC-9, Recessed Combination Paper Towel Dispenser and Waste Receptacle (ASI Model 0469, Bradley Model 234, Bobrick Model B-3944). Recessed Combination Paper Towel Dispenser and Waste Receptacle shall be constructed entirely of type 304 stainless steel, welded construction, with exposed surfaces satin finish. Flange shall be drawn, one-piece seamless construction. Paper towel dispenser shall have door with full-length stainless steel piano hinge and be equipped with tumbler lock. It shall be adaptable to dispense either C-Fold towels (capacity 500), Multifold towels (capacity 800) or Singlefold towels (capacity 1100). Removable waste container shall have a capacity of more than 1.5 cu. ft. and be secured to cabinet with tumbler lock.

C. AC-11, 38 mm Diameter Stainless Steel Grab Bars With Concealed Mounting (ASI 3201-36, Bradley 812-001-36, Bobrick Model B-6206 x 900 mm in length). Grab bar shall be constructed of type 304 stainless steel with satin finish. It shall have wall thickness of 1.2 mm and outside diameter of 38 mm. Distance from inside of grab bar to finished wall shall be 38 mm. Flanges shall be 3.2 mm stainless steel, 76 mm diameter and each shall have 4 stainless steel set screws.

Ends of grab bar shall pass thru flanges and be heliarc welded to form one structural unit. Concealed mounting plates shall be 2.3 mm stainless steel with 3 slotted screw holes.

D. AC-12, 38 mm Diameter All Stainless Steel Grab Bar (ASI Model 3201-42, Bradley 812-001-42, Bobrick Model B-6206 x 1070 mm in length). Grab bar shall be constructed of type 304 stainless steel with satin finish. It shall have wall thickness of 1.2 mm and outside diameter of 38 mm. Distance from inside of grab bar to finished wall shall be 38 mm. Flanges shall be 3.2 mm stainless steel, 76 mm diameter and each shall have 4 stainless steel set screws. Ends of grab bar shall pass thru flanges and be heliarc welded to form one structural unit. Concealed mounting plates shall be 2.3 mm stainless steel with 3 slotted screw holes.

E. AC-13, Stainless Steel Utility Hook (ASI Model 7340-S, Bradley Model 9115, Bobrick Model B-670). Utility Hook shall be constructed entirely of type 304 stainless steel.

F. AC-17, Soap Dispenser for Liquid soaps, Lotions, and Detergents (Bobrick Model B-822; Bradley Model 6324 & ASI Model 0332). Soap dispenser shall be type 304 stainless steel with satin finish. Corrosion-resistant valve shall dispense liquid soaps, lotions, and detergents. Container shall have a capacity of 1.0L. Unit shall have concealed, vandal-resistant mounting.

G. AC-21, Combination Toilet Seat Cover, Napkin Disposal & Toilet Tissue Dispenser, Recessed (Bradley Model B-3574, ASI Model 0482, Bradley Model 591). Combination Toilet Seat Cover, Napkin Disposal & Toilet Tissue Dispenser shall be constructed entirely of type 304 stainless steel welded construction. Exposed surfaces shall have satin finish. Flange shall be drawn, one-piece, seamless construction. It shall have a self-closing door equipped with full length stainless steel piano hinge. Theft-resistant spindles. Capacity: 5.7L Holds 1000 seat covers and two rolls of tissue.

H. AC-22, Combination Toilet Seat Cover, Napkin Disposal & Toilet Tissue Dispenser, Access Both Sides (Bradley Model B-357, ASI Model 0481, Bradley Model 5911). Combination Toilet Seat Cover, Napkin Disposal & Toilet Tissue Dispenser shall be constructed entirely of type 304 stainless steel welded construction. Exposed surfaces shall have satin finish. Flange shall be drawn, one-piece, seamless construction. Unit shall mount in partition and serve two toilet compartments. It shall have a self-closing door equipped with full length stainless steel piano hinge and a single stainless steel receptacle that can be serviced from one side only. Other wise of cabinet shall be built with a permanent panel. Theft-resistant spindles. Capacity: 5.7L Holds 1000 seat covers and four rolls of tissue, two for each compartment.

I. AC-23, Combination Toilet Seat Cover & Toilet Tissue Dispenser, Recessed (Bradley Model B-3474, ASI Model 0485, Bradley Model 5912). Combination Toilet Seat Cover & Toilet Tissue Dispenser shall be constructed entirely of type 304 stainless steel welded construction. Exposed surfaces shall have satin finish. Flange shall be drawn, one-piece, seamless construction. It shall have a self-closing door equipped with full length stainless steel piano hinge. Theft-resistant spindles. Capacity: Holds 1000 seat covers and two rolls of tissue.

J. AC-24, Combination Toilet Seat Cover & Toilet Tissue Dispenser, Access Both Sides (Bradley Model B-3471, ASI Model 0484, Bradley Model 592). Combination Toilet Seat Cover & Toilet Tissue Dispenser shall be constructed entirely of type 304 stainless steel welded construction. Exposed surfaces shall have satin finish. Flange shall be drawn, one-piece, seamless construction. Unit shall mount in partition and serve two toilet compartments. It shall have a self-closing door equipped with full length stainless steel piano hinge and a single stainless steel receptacle that can be serviced from one side only. Other side of cabinet shall be built with a permanent panel. Theft-resistant spindles. Capacity: Holds 1000 seat covers and four rolls of tissue, two for each compartment.

K. AC-25, Recessed Soap Dish (Bobrick Model B-438). Recessed heavy duty stainless steel soap dish shall be constructed entirely of 18-8, Type 304, stainless steel with satin finish. Soap dish and flange shall be drawn and beveled, one-piece seamless construction.

L. AC-26, 38 mm Diameter Stainless Steel Grab Bar with Concealed Mounting for 915 mm x 915 mm Shower Stall (Bobrick Model B-6861, ASI Model 3860). Grab bar shall be type-304 stainless steel with satin finish. Grab bar shall have 1.2 mm wall thickness and 40 mm outside diameter. Clearance between the grab bar and wall shall be 40 mm. Concealed mounting flanges shall be 3 mm thick stainless steel plate, 50 x 80 mm, and equipped with two screw holes for attachment to wall. Flange covers shall be 0.8 mm, 85 mm diameter x 13 mm deep, and shall snap over mounting flange to conceal mounting screws. Ends of grab bar shall pass through concealed mounting flanges and be heliarc welded to form one structural unit.

M. AC-27, Shower Curtain, Hooks, and Rod. Shower Curtain Rod (Bobrick Model B-6107 x 1025 mm) shall be Type-304, 1.0 mm stainless steel tubing with satin finish and 25 mm outside diameter. Flanges shall be Type-304, 1.0 mm stainless steel with satin finish and drawn, one-piece, seamless construction.

Shower Curtain (Bobrick Part No. 204-2, ASI Port No. 1200V x 1175 mm) shall be flame resistant, anti-bacterial. 8 gauge vinyl fabric. Rust resistant chrome-plated grommets nylon reinforced.

Shower Curtain Hooks (Bobrick Part No. 204-1, ASI Part No. 1200-SHU) shall be 2 mm diameter, Type-304 stainless steel. Hooks shall be usable with 25 and 32 mm diameter shower curtain rods.

N. AC-28, Folding Shower Seat (Bobrick Model B-517 (Right Hand) and B-518 (Left Hand). Folding shower seat shall have a frame constructed of Type-304, satin-finish stainless steel that consists of 1.6 mm, 30 mm square tubing and 1.2 mm, 25 mm diameter seamless tubing. Seat cushion shall be 35 mm

foam padding mounted on 13 mm thick marine grade plywood and covered in water-resistant reinforced vinyl fabric. Shower seat shall be equipped with two 75 mm diameter mounting flanges constructed of Type-304, 5 mm thick, satin-finish stainless steel; a guide bracket constructed of Type-304, 1.6 mm, satin-finish stainless steel; and a spring constructed of Type-301, 0.6 mm stainless steel that is spot welded to a base plate of Type-304, heavy-gauge stainless steel. Shower seat shall be able to lock in upright position when not in use.

NOTE: All grab bar installation shall withstand forces in excess of 300 lbs. All components and installation shall conform with the latest requirements.

END OF SECTION

SECTION 11134

PROJECTION SCREENS (MANUALLY OPERATED)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manually operated front projection screens.

1.2 Related Sections:

A. Section 06114 - Wood Blocking and Curbing.

B. Section 09111 - Metal Stud Framing System.

C. Section 09260 - Gypsum Board System.

1.3 REFERENCES

A. American Architectural Manufacturers Association

1. AAMA 606.1: Voluntary Guide specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.

2. AAMA 607.1-1977: Voluntary Guide Specification and Inspection Methods for Integral Clear Anodic Finishes for Architectural Aluminum.

3. AAMA 608.1-1977: Voluntary Guide Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

B. American Society for Testing and Materials:

1. ASTM B 221-90: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

2. ASTM C 1036-90: specification for Flat Glass.

3. ASTM D 1003-61 (1988): Test Method for Haze and Luminous Transmittance of Transparent Plastics.

4. ASTM D 4802-88: Specification for Poly(Methyl

Methacrylate) Acrylic Plastic Sheet.

C. Federal Specifications:

1. FS GG-S-00172D(1): Screen, Projection.

2. Federal Standard 191A/5760: Mildew Resistance of Textile Materials.

3. Federal Standard 191A/5903: Flame Resistance of Cloth; Vertical

D. National Fire Protection Association:

1. NFPA 701-1989: Standard Methods of Fire Tests for Flame-Resistant Textiles and Films.

1.4 SUBMITTALS: Submit the following under provisions of Section 01300.

A. Product data: screen specified.

B. Shop drawings: showing layout and types of projection screens. Show the following:

1. Location of screen centerline.
2. Anchorage details.
3. Accessories.
4. Frame details for front projection screens.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of projection screen required from a single manufacturer as a complete unit, including necessary mounting hardware and accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through partition.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and

installation of screens is ready to take place.

B. Protect screens from damage during delivery, handling, storage, and installation.

C. Store projection screens in manufacturer's protective packages in a position that complies with screen manufacturer's directions. Keep units in manufacturer's protective packages until time of installation.

D. Protect surfaces of projection screens from damage due to abrasion, dust, and other conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Da-Lite Screen Co., Inc. Product: Model C (800) 622-3737.

B. Draper Shade & Screen Co., Inc. Product: Luma 2 Screen (317) 987-7999.

C. Stewart Filmscreen Corp. Product: Luxus Communicator (800) 762-4999.

2.2 PROJECTION SCREEN SURFACES, GENERAL

A. Measurement of Gain of Screen Viewing Surface: Measure gain of screen viewing surface against that of a magnesium carbonate surface by means of a photogoniometer using test methods and test apparatus per FS GG-S-00172D(1) for determining effect of reflected light at various viewing angles on screen surfaces. Ratings of 1.0 refer to those viewing surfaces having a reflectivity equal to the magnesium carbonate surface.

B. Material and Viewing Surface of Front Projection Screens: Obtain screens manufactured from mildew- and flame-resistant fabric of type indicated for each type of screen specified and complying with the following requirements:

1. Matte white viewing surface with minimum gain characteristics complying with FS GG-S-00172D(1) for Type A screen surface.

a. Application: Provide matte white surfaces unless

otherwise indicated.

b. Edge Treatment: Without black masking borders.

2. Mildew Resistance: Provide mildew-resistant screen fabrics as determined by Federal Standard 191A/5760.
3. Fire Performance Characteristics: Provide projection screen fabrics identical to those materials that have undergone testing and passed requirements for flame resistance as indicated below:

   a. NFPA 701 per small-scale test.
   b. Federal Standard 191A/5903 for test method. FS GG-S-00172D(1) for flame resistance.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated in compliance with screen manufacturer's instructions.

B. Install projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.

3.2 PROTECTION AND CLEANING

A. Protect projection screens after installation from damage during construction. If despite such protection damage occurs, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 11165

DOCK BUMPERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dock bumpers of reinforced rubber with attachment frame.

1.2 RELATED SECTIONS

A. Section 05500 - Metal Fabrication: Steel angle cast into concrete dock edge.

B. Section 09900 - Painting: Field painting of exposed steel frame.

1.3 SUBMITTALS: Section 01300 - Submittals: Procedures for submittals.

A. Product Data: Indicate unit dimensions, method of anchorage, and details of construction.

B. Manufacturer's Installation Instructions: Indicate special installation requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Durable Corporation, Model B610-24.

B. Pawling Corporation, Model H1026.

C. Pioneer Manufacturing, Inc.

2.2 COMPONENTS

A. Bumpers: Fabric reinforced rubber pads, ozone resistant, laminated and compressed in position with two galvanized

steel rods with threaded ends, washers and nuts; between 75 x 60 x 6 mm galvanized steel angle end plates:
1. Projection From Wall: 115 mm.
2. Vertical Height: 250 mm.
3. Length: 600 mm.

B. Attachment Hardware: 19 mm diameter galvanized bolts and expansion shields.

C. Touch-up Primer: Zinc rich type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that anchor placement is acceptable.

3.2 PREPARATION

A. Provide integral anchors for placement by Section 03300.

3.3 INSTALLATION

A. Install dock bumpers in accordance with manufacturer's instructions.

B. Set plumb and level.

C. Secure angle end frames to concrete.

END OF SECTION

SECTION 11306

PACKAGE LIFT STATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B16.3	1992 Malleable Iron Threaded Fittings
ASME/ANSI B16.39	1986 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	1991 Structural Steel
ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 283/A 283M	1992 Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM C 478	1990 (Rev. B) Precast Reinforced Concrete Manhole Sections
ASTM C 913	1989 Precast Concrete Water and Wastewater Structures

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	1992 Structural Welding Code Steel

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110/A21.10	1987 Ductile-Iron and Gray-Iron Fittings, 3in. Through 48in., for Water and Other Liquids
AWWA C111/A21.11	1990 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	1988 Flanged Ductile-Iron Pipe with Threaded Flanges
ANSI/AWWA C151/A21.51	1991 Ductile-Iron Pipe, Centrifugally Cast,

	for Water or Other Liquids
AWWA C508	1982 Swing-Check Valves for Waterworks Service, 2 in. Through 24 in. NPS

HYDRAULIC INSTITUTE (HI)

HI SCRRP	1983 Centrifugal, Rotary & Reciprocating Pumps

MILITARY SPECIFICATIONS (MIL)

MIL-R-6855	(Rev. E) (Supp. 1) Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes
MIL-C-18480	(Rev. B) Coating Compound, Bituminous, Solvent, Coal-Tar Base

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-70	1990 Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-78	1987 (R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	1987 Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	1988 (Rev. 1-2) Industrial Control and Systems
NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section, with the additions and modifications specified herein.

1.3 LIFT STATION CRITERIA

1.3.1 Packaged Lift Station

Provide a complete, factory-built, automatic, underground pumping station with equipment factory installed in a welded steel chamber, precast concrete chamber with entrance tube and ladder or fiberglass enclosure. Principal items of equipment shall include two submersible, electric motor driven, non-clog sewage pump, valves, internal piping, central control

panel with circuit breakers or fused disconnects, motor starters and automatic controller, alternators, alarms, and internal wiring.

1.3.2 Performance Requirements

Operating capabilities shall be as scheduled and shown.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Packaged lift station

1.4.1.1 Data Contents

Submit pump performance data and curve, and literature describing the following:

a. Pumps

b. Motors

c. Equipment chamber

d. Control panel

e. Level control

1.4.2 SD-04, Drawings

a. Packaged lift station

b. Equipment foundations

Include outline dimensions, support details, cross section, and control wire diagram.

1.4.3 SD-08, Statements

a. Foundation approval certificate

When required by the Contracting Officer, obtain from equipment manufacturer approval of foundation design and construction for equipment involved.

1.4.4 SD-13, Certificates

a. Valves

1.4.5 NOT USED

1.4.6 SD-19, Operation and Maintenance Manuals

a. Packaged lift station

Submit operation and maintenance Data in accordance with normal industry practice, format and content of data to be approved by the Contracting

Officer.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Shipping

Ship station as one unit, unless size of plant prohibits such delivery. Where undeliverable as a single unit, ship in separate pieces designed for easy assembly in field and for sound structural strength of final assembly. Package other equipment and parts for shipment to prevent breakage, damage, or cause out-of-adjustment calibration readings of controls.

1.5.2 Handling

Handle station at site with machinery adequate to move safely and without damage to personnel or station. Use station lifting eyes and lugs provided for purpose of lifting station.

1.5.3 Storage

Protect from the weather and accidental damage. Store and handle cables carefully to avoid damage to outer covering or insulation and damage from moisture and weather. Protect electrical and mechanical equipment and accessories until installed and accepted. Structural materials, plain or fabricated, may be stored outdoors aboveground on platforms, skids or other supports. Keep materials free from dirt, grease, and other foreign matter during storage, and protect from corrosion.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel

2.1.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.1.2 Plate

ASTM A 283/A 283M, Grade C, bent or cold formed.

2.1.2 Sewage Piping and Fittings

2.1.2.1 Ductile-Iron Pipe

ANSI/AWWA C151/A21.51, thickness Class 50.

2.1.2.2 Flanged Pipe

AWWA C115/A21.15.

2.1.2.3 Fittings

AWWA C110/A21.10, flanged or mechanical joint. Provide flanged joint fittings within equipment enclosure and abovegrade. Provide mechanical joint fittings outside equipment enclosure underground.

2.1.2.4 Joints

AWWA C111/A21.11 for mechanical joints.

2.1.3 Small Piping (Under 50 mm) and Fittings

2.1.3.1 Pipe

ASTM A 53, standard weight, zinc-coated.

2.1.3.2 Fittings

ANSI/ASME B16.3, Class 150, zinc coated.

2.1.3.3 Unions

ASME/ANSI B16.39, Class 150.

2.1.4 Valves

Valve pit shall be provided either adjacent to or cast integral into the pump station to house the check valves and discharge pipe connections, gate valves and cleaning port.

2.1.4.1 Gate Valves

MSS SP-70, Type III, Designation NT, iron, Class 125.

2.1.4.2 Plug Valves

MSS SP-78, Type II or IV, Class 125, flanged ends, lubricated.

2.1.4.3 Check Valves

AWWA C508, horizontal or vertical, bronze or resilient seats, gates, and equipped with closing springs.

2.1.4.4 Small Globe and Check Valves (Under 50 mm)

MSS SP-80, Class 150.

2.1.5 Miscellaneous Metals

Bolts, nuts, washers, anchors, and supports necessary for the installation of equipment shall be stainless steel, wrought-iron or steel zinc coated in conformance to ASTM A 153.

2.1.6 Concrete

Provide concrete with a 28 day compressive strength of 20.7 MPa in accordance with Section 03300, "Cast-In-Place Concrete."

2.2 UNDERGROUND EQUIPMENT ENCLOSURE

Provide equipment chamber having structural strength necessary to withstand transportation and installation without undue buckling, distortion, or other defects. Provide a minimum 2.1 m clearance from floor to lowest obstruction to allow disassembly of equipment.

2.2.1 Steel

Provide a vertical cylinder with reinforced heads top and bottom. Provide minimum 6 mm thick circular steel sleeves through sides to accommodate piping.

2.2.1.1 Walls and Floor

Fabricate sides and top of chamber from minimum 6 mm plate. Fabricate bottom using minimum 8.5 mm plate. Properly place structural members on top, sides and bottom to withstand imposed soil, traffic, and hydraulic loadings.

2.2.1.2 Entrance Tube

0.9 m diameter minimum, rolled from minimum 6 mm steel plate, and of length necessary to place cover at required elevation aboveground. Reinforce lower end with a rolled angle and top by a deep rolled bead. Cover upper edge with a heavy extruded neoprene gasket conforming to MIL-R-6855, Type II, shaped to an inverted "U" and firmly cemented inside and out.

2.2.1.3 Entrance Tube Lid

Provide 3 mm minimum thickness steel or aluminum plate, with minimum 37 mm deep flange, or an approved fiberglass reinforced plastic. Provide a wind-latch to engage the lid in open position. Provide a frost-proof cylinder-type lock that can be opened from inside without a key.

2.2.1.4 NOT USED

2.2.1.5 NOT USED

2.2.1.6 Lifting Loops and Lugs

Provide lifting loops of suitable size and strength in enclosure ceiling where necessary to facilitate maintenance or removal of equipment. Provide lugs for handling and installation of equipment chamber and entrance tube.

2.2.1.7 Structural Shapes

Provide 6 mm minimum thickness structural shapes for reinforcing and bracing except as specified otherwise herein.

2.2.1.8 Welding

AWS D1.1.

2.2.2 Precast Concrete

ASTM C 478 for circular structures and ASTM C 913 for all other shapes. Provide lifting loops within enclosure. Provide entrance lid of steel plate aluminum, or fiberglass reinforced plastic.

2.3 NOT USED

2.4 PUMPING EQUIPMENT

2.4.1 NOT USED

2.4.2 NOT USED

2.4.3 Submersible Sewage Pumps

Provide submersible, centrifugal sewage grinder pumps of the non-clogging type with passageways designed to pass 25 mm diameter spheres without clogging. Design pump to operate in a submerged or partially submerged condition. Provide an integral sliding guide bracket and two guide bars capable of supporting the entire weight of the pumping unit.

2.4.3.1 Casing

Provide hard, close-grained cast iron casing which is free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects. Design casings to permit replacement of wearing parts. Passageways shall permit the smooth flow of sewage and shall be free from sharp turns and projections.

2.4.3.2 Impeller

Provide non-clogging type cast-iron impeller. Make impeller with smooth surfaces, free flowing with the necessary clearance to permit objects in the sewage to pass. Fit and key, spline, or thread impeller on shaft, and lock in such manner that lateral movement will be prevented and reverse rotation will not cause loosening.

2.4.3.3 Shaft and Shaft Seals

Provide shaft of stainless steel. Provide mechanical seal of double carbon and ceramic construction with mating surfaces lapped to a flatness tolerance of one light band. Hold rotating ceramics in mating position with stationary carbons by a stainless steel spring. Oil lubricate bearings.

2.4.3.4 Bearings

Provide heavy duty ball thrust bearing or roller type bearing of adequate size to withstand imposed loads. Oil lubricate bearings.

2.4.4 Pump Motor

Provide a solid-shaft, submersible, squirrel cage induction motor. Motor horsepower shall be not less than pump horsepower at any point on the pump performance curve. Fit motors with lifting "eyes" capable of supporting entire weight of pump and motor.

2.4.5 Pump Control System

Provide a float switch control system. Design to start pump at indicated high water and stop at indicated low water. Automatically alternate operation from one pump to the other and start second pump in the event first pump cannot handle incoming flow. Provide manual "on-off" switch for each pump. Provide independent adjustable high and low water level switches. Provide high wet well alarm switch. Pump controls, alarms, and related equipment shall be mounted in an exterior, weatherproof, pedestal mounted enclosure located adjacent to the pump station.

2.5 NOT USED

2.6 ELECTRICAL EQUIPMENT

2.6.1 NOT USED

2.6.2 Control Panel

NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6. Pedestal mount in a protected location. The panel, components, and wiring shall be in accordance with NFPA 70. The enclosure shall meet requirements of NEMA Type 4X construction. Divide control panel into two separate compartments, one to house controls for 120 volt and lower and the other to house higher voltage controls. Circuit breakers or fused disconnects, selector switches, and gages shall be front-panel mounted or extended through die-cut openings in the front cover or face plate. No reciprocating or vibrating equipment will be permitted within or mounted on the control panel. Color code internal wiring in accordance with furnished diagrams. Permanently and visibly identify switches, control relays, circuit breaker or fused disconnects, and other components, both inside and out. Provide each motor with properly sized, non-reversing, magnetic, across-the-line type starters with overload protection, under-voltage release, and hand-off-automatic selector switch. Include switches for manual operation. Provide a convenience outlet for operation of 110 volt devices.

2.6.3 Wiring

Factory wire station in accordance with NFPA 70. Install wiring from control panel to junction boxes adjacent to equipment in rigid conduit. Install wiring from junction boxes to equipment in flexible conduit, except that accessory items may be plug-connected by insulated service cord to junction boxes. Color code wiring. Wiring subject to flexing during service, such as that from a stationary part to a part mounted on a hinged door, shall be provided with additional insulation at points it is flexed, unless wiring is flexible cord. Install feeder lines from control panel in rigid conduit.

2.6.4 Elapsed Running Time Meter

Provide an elapsed running time meter, totalizing type to register total "on" time in hours, for each pump in the lift station.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Equipment Foundations

Provide foundations and anchorage in accordance with drawings and requirements of the respective equipment manufacturers. When required by the Contracting Officer, obtain from the equipment manufacturer the foundation approval certificate of the design and construction for the equipment involved. Dampen and isolate equipment vibration.

3.1.2 Equipment Installation

Install equipment in accordance with these specifications and the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before installing piping. Install piping to avoid imposing stress on any equipment. Match flanges accurately before securing bolts.

3.1.3 Posted Operating Instructions

Provide for packaged lift stations.

3.2 MATERIALS PROTECTION

3.2.1 Painting

Perform painting in the field or shop. However, when touch-up of shop-painted surfaces is required, perform in the manner specified herein.

3.2.2 Metal Surfaces

Coat metal surfaces, except aluminum, bronze, and brass, with a coal tar base conforming to MIL-C-18480, applied in not less than two coats, to a minimum dry film thickness of 40 mils. Before coating, clean metal surfaces of rust, mill scale, oil, grease, dirt, slag, flux, weld spatter, or other foreign substances.

3.2.3 Cathodic Protection

Provide cathodic protection for steel lift stations to inhibit galvanic corrosion. Furnish 7.7 kg magnesium anode packs complete with 3 m copper wire leads in good electrical contact with the steel of the chamber.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Performance Testing

In the presence of the Contracting Officer and the field engineer of the manufacturer, test equipment for a minimum of one day. Perform measurement of head test and capacity measurement by head type meter test in accordance with HI SCRRP. Equipment shall be free of cavitation, excess vibration, and over-heating and safety devices shall be demonstrated to perform as scheduled on drawings and specified within control sections of these specifications. Immediately correct discrepancies encountered between specified performance and field performance.

-- End of Section --

SECTION 11311

PARALLEL PLATE, GRAVITY OIL-WATER SEPARATOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)

APHA SMEWW	Examination of Water and Wastewater

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1993; Rev. A) Structural Steel
ASTM E 165	(1992) Liquid Penetrant Examination

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA MCAWW	Chemical Analysis of Water and Wastes

FEDERAL SPECIFICATIONS (FS)

FS SS-S-210	(Rev. A Reinst) Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

MILITARY SPECIFICATIONS (MIL)

MIL-S-45180	(Rev. D) Sealing Compound, Gasket, Hydrocarbon Fluid and Water Resistant

1.2 SYSTEM DESCRIPTION

1.2.1 Applications

The separator shall remove free oil and suspended solids from oil-in-water mixtures of freshwater originating from aircraft maintenance operations. The influent oil-in-water mixture will flow by gravity to the unit.

1.2.2 Influent Characteristics

Provide oil-water separator designed for a maximum flow of 3.16 liters per second . Operating temperatures of the influent oil-in-water mixture will range from 4 to 80 degrees C. The specific gravities of the oils at operating oil-water temperatures will range from 0.7 to 0.95 and the petroleum hydrocarbon concentration less than or equal to 200,000 milligrams per liter (mg/L). The specific gravity of the freshwater at

operating temperatures will range from 1.00 to 1.03.

1.2.3 Performance Requirements

The petroleum hydrocarbon concentration in the effluent from the oil-water separator shall not exceed the following limitations:

Contaminants	Maximum
Petroleum hydrocarbon, daily maximum	10 mg/L

To achieve this goal, it will be necessary to remove all free oil droplets equal to or greater than 20 microns.

1.3 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.3.1 SD-04, Drawings

a. Separator GA

b. Accessory equipment GA

Submit shop drawings for separator and accessory equipment including principal dimensions, location of fittings and unit foundation. Include data to verify center of gravity with the unit empty and filled with water.

1.3.2 SD-05, Design Data

a. Separator GA

Submit analysis, signed by a registered professional engineer, which indicates that at the calculated overflow rate, the separator will be provided with the required square meter of projected plate separation area to achieve the specified performance under laminar flow (i.e. Reynolds number of less than 500) conditions. Calculations shall take into account the rate of flow, potential surge flow, influent concentrations, particle characteristics, fluid temperature, fluid specific gravities, and pH.

1.3.3 SD-06, Instruction

a. Separator system GA

1.3.4 SD-11, Factory Test Reports

a. Shop hydrostatic test GA

Submit results of hydrostatic and dynamic testing.

1.3.5 SD-12, Field Test Reports

a. Inspection

b. Field hydrostatic test

c. Preoperational test

d. In-service test

1.3.6 SD-13, Certificates

a. Separator corrosion protection GA

Submit written verification on the fabricator's letterhead that surface preparation and coating application were performed in accordance with the manufacturer's printed recommendations for the coating system.

1.3.7 SD-19, Operation and Maintenance Manuals

a. Separator system GA, Data Package 3

b. Accessory equipment G, Data Package 3

Submit operation and maintenance data based upon the manufacturer's recommendations.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, such as subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. If special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.

1.4.2 Handling

Handle separator in such a manner as to ensure delivery to final location in sound, undamaged condition. Take special care not to damage interior and exterior surfaces of separator, coalescing plates, and associated supports and pipe coatings or linings. Make satisfactory repairs to damaged materials at no cost to Government. Carry and do not drag materials.

PART 2 PRODUCTS

2.1 MATERIALS

Use 4.8 mm minimum thick carbon steel conforming to ASTM A 36/A 36M or material having equivalent structural properties and corrosion resistance for tank, hoppers, stationary and adjustable weirs, nozzles, flow distributor and energy dissipator device, bolts, seals, stiffeners, washers, and nuts. Weld in accordance with AWS D1.1 to provide watertight tank that will not warp or deform under load. Use welders qualified in accordance with AWS Standard Qualification Procedure. Grind welds smooth and remove weld spatter. Fabricate free of kinks and sharp bends in a manner not to reduce the strength of steel to a value less than that intended by the design. Size and shape of bends shall be uniform. Clean and finish carbon steel surfaces as described in paragraph entitled "Separator Corrosion Protection."

2.1.1 Separator Corrosion Protection

2.1.1.1 Steel Separator

Provide corrosion protection in accordance with Steel Tank Institute, STI-P3.

2.1.1.2 Other Than Steel Separator

After shop conducted hydrostatic tests and have been successfully completed, provide a coating system which will protect the separator from the oil-in-water mixture, and in situ soil conditions specified herein.

2.1.1.3 Cathodic Protection

For below ground metal separators, provide cathodic protection with test stations as recommended by the manufacturer and approved by the Contracting Officer in addition to the protective coating.

2.1.2 Substitutions

Separators constructed of reinforced fiberglass may be provided in lieu of carbon steel. Provide fiber glass tanks with lifting straps. Glass fiber reinforced plastic weirs may be accepted as a suitable weir and baffle material provided that necessary requirements for anchorage of these items include provisions for contraction and expansion. Surfaces shall be seamless, chemically resistant to oil-in-water mixture, and resistant to ultraviolet deterioration.

2.1.3 External Surfaces

External tank surfaces and appurtenances shall be resistant to corrosion from the in situ soil, groundwater, soil resistivity.

2.1.4 Internal Surfaces

Parallel plate material and orientation shall enhance oil coalescence and solids removal, and be corrosion and chemically resistant to the oil-in-water mixture as specified in paragraph entitled "SYSTEM DESCRIPTION."

2.1.5 Hardware

Bolts, stiffeners, washers, nuts, screws, pins, and fittings as required shall be corrosion resistant. Provide materials that are inherently corrosion resistant and not merely treated with a corrosion-resistant coating, such as provided by the galvanizing process.

2.1.6 Accessibility

Parts subject to wear or requiring adjustment, inspection, cleaning or repair shall be accessible and capable of convenient removal when required.

2.2 TANK

Provide below ground tank to withstand hydraulic and soil loadings under static and dynamic conditions while empty and during operating conditions. Provide adequate support for additional loadings from tank appurtenances

including weirs, hoppers, internal supports, parallel plate oil coalescers, equipment transportation, and rapid lowering and braking of load during handling operations. Bolt tank and accessories to weld-fabricated, structural steel skid base, or mount on manufacturer's standard base.

2.2.1 Lifting Mechanism

Fit tank with lifting lugs, straps and supports for handling and installation. Each support shall carry the total dry weight of the tank and attendant appurtenances. Prominently display lifting instructions on plate located on outside of tank.

2.2.2 NOT USED

2.2.3 NOT USED

2.2.4 NOT USED

2.2.5 Low Point Drains

Provide means at low points for dewatering tank.

2.2.6 Identification Plates

Provide identification and instruction plates and stamp necessary data. Securely affix plates, in prominent location, to tank with nonferrous screws or bolts of not less than 3 mm in diameter.

2.2.7 Instruction Plates

Instruction plates shall describe special or required procedures to operate and service equipment, and shall include warnings of hazardous procedures and notice of safety and health requirements. Plates shall be durable and legible throughout equipment life.

2.2.8 Warning Sign

On entrances to the tank (and entrances to the vault) place a permanent sign which states the following: "DO NOT ENTER TANK (OR VAULT) OR PERFORM HOT WORK ON OR IN TANK UNTIL THE ATMOSPHERE HAS BEEN TESTED AND CERTIFIED GAS FREE AND SAFE."

2.3 INLET COMPARTMENT

Provide inlet compartment of sufficient volume to effectively reduce influent suspended solids and dissipate energy. Provide nonclogging flow distributor and energy dissipator device and the primary solids collection hopper as specified in paragraph entitled "Reduction of Solids". Locate sample ports as recommended by the manufacturer.

2.4 OIL COALESCING COMPARTMENT

2.4.1 Parallel Plates

Provide parallel plates at an angle from 0.70 to 1.05 rad with respect to longitudinal axis of the plate corrugations and space not less than 6 mm and not more than 19 mm apart for removal of free oil and settleable solids. Configuration used shall not promote solids buildup on plates which would increase velocities to point of discharging an effluent of

unacceptable quality. Maintain laminar flow at maximum design flow rate throughout plate packs including entrance and exit so as to prevent re-entrainment of oil(s) with water. Flow through plate packs shall be in a downflow mode parallel to plate corrugations or cross-flow perpendicular to plate corrugations, so that the oil collects and coalesces at high point of corrugations and rises to top of pack without clogging from oil or settleable solids.

2.4.2 NOT USED

2.4.3 Supports

Brace and support individual plates or plate packs to withstand loads associated with transportation and operation of units, including inplace cleaning. Equip each plate pack with lifting lugs or other attachments for handling and installation. Each lug shall carry total weight of plate pack. Provide adequate structural supports to facilitate inplace cleaning of plate pack bundles.

2.4.4 Baffles

Provide oil retention baffle, adjustable surface oil overflow weir with trough, and stationary underflow baffle. Position underflow baffle to prevent resuspension of solids that have accumulated in secondary solids hopper.

2.5 OUTLET COMPARTMENT

Provide outlet compartment, an adjustable overflow effluent weir, a sampling port, and nozzles.

2.6 ACCESSORIES AND ACCESSORY EQUIPMENT

Provide bolts, stiffeners, washers, nuts, screws, pins, gaskets, and fittings as required for adjustable weirs, and parallel plate packs.

2.6.1 Manholes

Furnish two 24" diameter manholes complete with extentions, cover, gaskets and bolts.

2.6.2 System Controls

Furnish intrinsically safe oil level controls to activate high level alarm at predetermined level. All enclosures to be NEMA certified.

2.7 FABRICATION

Provide shop fabricated, skid mounted oil-water separator, or other shop fabricated unit approved by the Contracting Officer, which is comprised of a tank containing an inlet compartment, parallel plate oil coalescing compartment, outlet compartment and all specified accessories.

2.7.1 Shop Hydrostatic Test

Prior to applying coatings, perform hydrostatic test at atmospheric pressure by filling tank with water in the shop for a minimum of 4 hours. Testing shall be conducted after all seams have been cleaned and all welds have been inspected in accordance with ASTM E 165. Acceptance criteria,

for the hydrostatic test, is no leakage after 4 hours using a thorough visual inspection for the leaks.

2.7.2 Reduction of Solids

Inlet compartment shall reduce settleable solids to nonclogging level for parallel plates and provide a uniform oily wastewater hydraulic loading across inlet face of oil coalescing compartment, under laminar flow conditions. Submit proof that separator will not clog given the influent characteristics. Equip compartment with an inlet nozzle with wastewater sampling port, nonclogging flow distributor and energy dissipator device. The oil-water separator shall be preceded by a solid water basin which includes a removable solids or trash basket. Equip the solid water basin with a hoist for servicing the trash basket. Size the basket to retain all solids larger than 75 mm in any dimensions. The solid waste basin shall have a minimum storage volume of 945 liters.

2.7.3 Oil Coalescing Compartment

Equip oil coalescing compartment with easily removable and reinstallable, parallel, corrugated plates arranged to optimize separation of free oil from liquid carrier. Provide adjustable surface oil overflow weir with trough, oil outlet nozzle and stationary underflow baffle, oil retention baffle positioned to prevent discharge of free oil that has been separated from the carrier liquid in inlet and oil coalescing compartments. Provide access to each plate pack from top. Each bundle shall be equipped with handles or lifting rings. Plate designs that permit cleaning of plate packs in place are acceptable. When plate design permits cleaning in place, provide sufficient access to permit complete cleaning of the plates and removal of the sludge.

2.7.4 Wastewater Sampling Port

Equip inlet and outlet compartments, adjustable overflow effluent weir, effluent trough, and wastewater outlet nozzle with wastewater sampling ports permitting easy access for obtaining isokinetic influent and effluent samples.

2.7.5 Connections

Connect the separator at the inlet and outlet pipe invert elevations indicated. Follow equipment manufacturer's recommendation for setting and adjusting top of weir elevations throughout unit.

2.7.6 Storage

Provide oil and suspended solids collection, storage, and transfer systems as an integral part of proposed oil-water separator system. As a minimum, the tank shall have an oil storage capacity of 43% of total tank volume, and an emergency oil spill capacity of 80% of the total tank volume.

PART 3 EXECUTION

3.1 INSPECTION

Inspect each component of separator for compliance with requirements specified in PART 2 PRODUCTS. Redesign or modification of equipment to comply with specified requirements, or necessary redesign or modification following failure to meet specified requirements, shall receive particular

attention for adequacy and suitability. This element of inspection shall encompass visual examinations and dimensional measurements.Noncompliance with specified requirements, or presence of one or more defects preventing or lessening maximum efficiency of separator operation, shall constitute cause for rejection.

3.2 INSTALLATION

Lift tank as required without parallel plate packs in place onto level foundation using lifting mechanism provided. Level tank and bolt to supports to prevent hydrostatic uplift and ensure unit stability. Use a lifting bar through lugs to insert plate packs into tank and place on supports. Caulk around packs and pack supports with sealing compound conforming to FS SS-S-210 or to MIL-S-45180 to prevent hydraulic short-circuiting. Avoid abrupt contact between the packs and the tank walls and pack supports to avoid damage. Separator systeminstallation shall be conducted in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Hydrostatic Test

After separator has been leveled and secured to foundation and parallel plate packs are in place, level effluent overflow weir at elevation specified by manufacturer and hydrostatically test unit at atmospheric or operational pressure (for no leakage) for an additional 8 hours by filling with water. Perform the hydrostatic test prior to backfilling below ground or partially below ground installations.

3.3.2 Preoperational Test

The manufacturer's service representative shall inspect, operate, and test unit before in-service testing by the Contractor.

3.3.2.1 Tests

Tests shall include but not be limited to the following:

a. Soundness (without cracked or otherwise damaged parts).

b. Completeness in all details, as specified.

c. Correctness of setting, alignment, and relative arrangement of each component.

d. Verification of proper operation for all system components.

3.3.2.2 Preoperational Investigation and Test Report

Submit manufacturer's service representative's preoperational test report. Document inspections, operations, adjustments, and tests performed and indicate whether they were acceptable or not. For unacceptable items, describe corrective action taken or recommended. Include detailed descriptions of points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. Include the manufacturer's certificate that equipment conforms to specified requirements and is ready for permanent operation and that nothing in installation will render manufacturer's warranty null and void.

3.3.3 In-Service Test

After hydrostatic test and preoperational test have been successfully completed and unit has been properly connected to influent and effluent piping, allow influent oil-in-water mixture previously described in paragraph entitled "SYSTEM DESCRIPTION" to flow into separator filled with water. Adjust and level primary and secondary surface oil overflow weirs to optimize oil skimming and minimize water overflow to oil recovery. Optimize operation of unit within 5 working days. Operate unit for a minimum of ten tank volume changes prior to testing for removal of contaminants and document testing results.

3.3.3.1 Analytical Methods

Test and sample preservation methods for test contaminants shall be in accordance with the latest revisions of APHA SMEWW, APHA Standard Methods for the Examination of Water and Wastewater, EPA MCAWW, EPA Methods for Chemical Analysis of Water and Wastes, or those substitute methods approved by the governing regulatory agencies having jurisdiction.

3.3.3.2 Test for Contaminants

Verify the separator efficiency by testing influent and effluent for contaminants described in paragraph entitled "Performance Requirements." If effluent quality is found to be unacceptable, then verify influent to effluent performance in particle size removal at the site. Tests shall be performed by an independent certified testing laboratory.

3.3.3.3 Sampling Procedures

Within an 8 hour period and at regular intervals collect a minimum of 10 influent and effluent samples from sampling ports provided as part of the separator. Purge each sampling port to remove built-up solids or other material prior to collecting sample. Collect wastewater samples isokinetically in clean glass containers with polytetrafluoroethylene lined caps. Collect duplicate wastewater samples in separate glass containers. Do not attempt to split sample. Use containers for other contaminants as recommended in references listed in paragraph entitled "Analytical Methods."

3.3.3.4 Acceptance Criteria

90 percent of the effluent samples taken shall not exceed the specified daily maximum limit for petroleum hydrocarbon contaminants. If the separator does not meet requirements of this specification, due to poor workmanship and wrong fabrication dimensions, the unit may be rejected. If the unit is not operating at design efficiency 5 days after installation, Government may reject system. In the event Government rejects unit, Contractor shall remove separator or defective components and replace with acceptable unit or components and test as specified above.

-- End of Section --

SECTION 12512

HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Horizontal slat louver blinds.

B. Operating hardware.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 08520 - Aluminum Window: Wall opening head support brackets.

1.3 RELATED SECTIONS

A. Section 06114 - Wood Blocking and Curbing: Wall opening head support blocking.

B. Section 08520 - Aluminum Window: Window framing and interior reveals.

1.4 SYSTEM DESCRIPTION

A. Horizontal slat louver blinds installed at window openings; manual control of raising and lowering by cord for full range locking; blade angle adjustable by control wand.

1.5 SUBMITTALS: Make submittals in accordance with Section 01300.

A. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.

B. Product Data: Provide data indicating physical and dimensional characteristics,and operating features.

C. Samples: Submit two samples, 25.4 mm long illustrating slat

materials and finish, color, rod type and color.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.8 COORDINATION

A. Coordinate the work with window installation and placement of concealed blocking to support blinds.

1.9 EXTRA MATERIALS

A. Provide ten additional slats.

B. Provide two additional complete blind assemblies of each size.

C. Provide two extra control rods.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hunter Douglas Inc., Two Park Way
Upper Saddle River, N.J.
Product: Contract Viscount 25 mm Aluminum Blinds

B. Levolar, 25 Grunpond Rd, Rockaway, N.J.
Product: Riveria 25 mm Contract Blind

Modular Design System

C. Springs Window Fashions Division Inc.
Product: Bali Classics Custom 25 mm wide aluminum blinds

2.2 MATERIALS

A. Metal Slats: 25 mm wide; 0.28 mm thick spring tempered pre-finished aluminum horizontal slats, square slat corners, with manufacturing burrs removed.

B. Slat Support: Woven polypropylene, ladder configuration.

C. Head Rail: Pre-finished, formed steel box; internally fitted with hardware, pulleys, and bearings for operation.

D. Control Wand: Extruded hollow plastic; square shape; non-removable type; length of window opening height plus 75 mm.

E. Head Support Bracket: Overhead head rail attachment; provide to Section 08520 for installation.

F. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FINISHES

A. Blind Slat and Head Rail Housing: color as selected.

B. Control Wand: color as selected.

2.4 FABRICATION

A. Fabricate blinds to fit openings with uniform edge clearance 3.1 mm.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings are ready to receive the work.

B. Ensure structural blocking and supports are correctly placed.

3.2 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.

B. Secure in place with flush countersunk fasteners.

C. Place intermediate head supports at spacing recommended by the blind manufacturer.

3.3 INSTALLATION TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 3.1 mm.

B. Maximum Offset From Level: 3 mm.

3.4 ADJUSTING

A. Adjust blinds for smooth operation.

Modular Design System

3.5 CLEANING

A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 13080

SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1996) Carbon Structural Steel
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1994) Carbon and Alloy Steel Nuts
ASTM A 603	(1994) Zinc-Coated Steel Structural Wire Rope
ASTM A 653	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1990) Strength of Anchors in Concrete and Masonry Elements
ASTM E 580	(1991) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1981; Supple 1991; R 1992) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO-01	(1994) Uniform Building Code (3 Vol.)

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-12	(1991; Appx E, 1993) Seismic Restraint Manual Guidelines for Mechanical Systems

UNDERWRITERS LABORATORIES (UL)

UL 1570	(1995) Fluorescent Lighting Fixtures
UL 1571	(1991; Rev thru Mar 95) Incandescent Lighting Fixtures

1.2 SYSTEM DESCRIPTION

1.2.1 General

The requirements for seismic protection measures described in this section shall be applied to mechanical/electrical equipment and systems specified herein. Seismic protection requirements shall be in accordance with ICBO-01 using an importance factor of 1.15 and shall be provided in addition to any other requirements called for in other sections of these specifications. This facility shall be designed as being in seismic zone 1; no other zone values shall be used to establish bracing requirements. Lateral support against earthquake induced forces shall be accomplished by positive attachments without consideration of friction resulting from gravity loads.

1.2.2 Mechanical/Electrical Equipment

Mechanical/electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Boilers
Water Heaters
Expansion Air Separator Tanks
Bridge Cranes and Monorails
Water Chiller Units
Control Panels
Pumps with Motors
Light Fixtures
Switchboards (Floor Mounted)
Suspended Ceiling Assemblies
Unit Heaters
Exhaust and Return Fans
Air Compressors
Makeup Air Units
Storage Tanks for Water
Water and Gas Piping
Cable Trays
Air Handling Units
Switchgear
Transformers
Storage Racks
Ducts
Infrared Heaters

1.2.3 Mechanical/Electrical Systems

The following mechanical and electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

All Piping Inside the Building in Accordance With This Specification
Air Handling Ductwork
All Water Supply Systems
Sanitary Sewer Systems

All Process Piping

1.2.4 Equipment and Systems

The bracing for the following mechanical/electrical equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification: All systems indicated in Paragraph 1.2.2 and 1.2.3 above.

1.2.5 Exclusion

Seismic protection of piping for fire protection systems shall be installed as specified in Sections 15310 FIRE PROTECTION PIPING, and 15325 SPRINKLER SYSTEMS.

1.2.6 Pipes and Ducts Requiring No Special Seismic Restraints

Seismic restraints may be omitted from the following installations:

a. Gas piping less than 25 mm inside diameter.

b. Piping in boiler and mechanical equipment rooms less than 32 mm inside diameter.

c. All other piping less than 38 mm inside diameter.

d. Electrical conduit less than 64 mm inside diameter.

e. Rectangular air handling ducts less than 0.37 square meters in cross sectional area.

f. Round air handling ducts less than 457 mm (18 inches) in diameter.

g. Piping suspended by individual hangers 300 mm or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.

h. Ducts suspended by hangers 300 mm or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions g. and h. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced.

1.2.7 All Other Interior Piping, Conduit, and Ducts

Interior piping, conduit, and ducts not covered by paragraphs Exclusion or Pipes and Ducts Requiring No special Seismic Restraints shall be seismically protected in accordance with the provisions herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 15010.

Data

Bridge Cranes and Monorails. Bracing and Coupling. Lighting Fixtures in Buildings. Miscellaneous Equipment.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Drawings

Bracing and Coupling. Flexible Couplings or Joints. Resilient Vibration Isolation Devices. Bridge Cranes and Monorails. Lighting Fixtures in Buildings. Miscellaneous Equipment.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Certificates

Flexible Ball Joints.

Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer, based on not less than 2 years' satisfactory operation in a similar application.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the requirements specified below:

2.1.1 Bolts and Nuts

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153.

2.1.2 Sway Bracing

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A 36.

b. Wire rope, ASTM A 603.

c. Tubes, ASTM A 500, Grade B.

d. Pipes, ASTM A 53, Type E, Grade B.

e. Light gauge angles, less than 6 mm thickness, ASTM A 653.

2.1.3 Flexible Couplings

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe specified in other sections.

2.1.3.1 Flexible Ball Joints

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement.

2.1.3.2 Flexible Mechanical Joints

a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be high-strength type as specified above.

2.1.4 Lighting Fixture Supports

Fixture supports shall be malleable iron. Lighting fixtures and supports shall conform to UL 1570 or UL 1571 as applicable.

PART 3 EXECUTION

3.1 BRACING AND COUPLING

Bracing and coupling shall conform to the requirements of TM 5-809-10. Provisions of this paragraph apply to all piping within a 1.5 m line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two 13 mm bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

Sway braces for a run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Joints capable of accommodating seismic displacements shall be provided where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. For threaded piping, swing joints shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 meters per meter of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

3.3 FLEXIBLE COUPLINGS OR JOINTS

3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 90 mm in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets or no-hub fittings may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to comply with these requirements.

3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve.

3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 100 mm apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields the same as required for piping in hangers.

3.6 ANCHOR BOLTS

3.6.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. Two nuts shall be provided on each bolt. Anchor bolts shall conform to the following tabulation for the various equipment weights and specified seismic zone or the manufacturer's installation recommendations, whichever is the most stringent, unless otherwise shown on the drawings. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

3.6.2 Minimum Bolt Sizes, Cast-In-Place Anchor Bolts

Maximum Equipment	Minimum Bolt Sizes (mm)*				
Weight (Kg)	Zone 4	Zone 3	Zone 2A	Zone 2B	Zone 1
225	13	13	13	13	13
450	13	13	13	13	13
2250	13	13	13	13	13
4500	13	13	13	13	13
9000	13	13	13	13	13
13500	16	13	13	1	13
22500	22	16	13	13	13
45000	**	**	16	22	13

*Based on four bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Equivalent total cross-sectional area shall be used when more than four bolts per item are provided. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to

at least 12 times nominal diameter of the bolt.

3.6.3 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. The expansion anchor size shall be not less than that required in paragraph Minimum Bolt Sizes, Cast-In-Place Anchor Bolts. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.6.3.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

3.6.3.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 30 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 9 mm sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

3.7 RESILIENT VIBRATION ISOLATION DEVICES

Selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS except that an equipment weight equal to five times the actual equipment weight shall be used.

3.7.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 15 mm.

3.8 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

3.8.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those given in the tabulation below as modified for each seismic zone. All runs shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in other sections.

3.8.2 Maximum Span for Transverse Sway Braces in Seismic Zone 4

Pipe Diameter	Std. Wgt. Steel Pipe - 40S		Ex. Strong Steel Pipe - 80S		Copper Tube Type L	
(mm)	*L(m)	**F(kN)	*L(m)	**F(kN)	*L(m)	**F(kN)
25	6.7	0.30	6.7	0.4	3.4	0.08
40	7.6	0.60	7.9	0.8	3.7	0.16
50	8.8	1.0	9.1	1.3	4.3	0.30
65	9.8	1.7	10.0	2.1	4.8	0.50
80	10.4	2.5	10.7	3.2	5.2	0.70
90	11.0	3.3	11.6	4.1	5.5	1.0
100	11.9	4.3	12.2	5.3	5.8	1.3
125	12.5	6.4	13.4	8.5	6.1	2.1
150	13.7	9.4	14.0	12.2	6.7	3.3
200	14.9	16.6	16.5	22.9	7.9	6.9
250	16.5	27.1	18.0	34.1	8.5	11.7
300	17.7	38.1	18.6	46.0	9.4	17.6

*L = Maximum span between lateral supports multiplied by 1.1 for Zone 3, 1.25 for Zone 2A, 1.2 for Zone 2B, or 1.35 for Zone 1.

**F = Horizontal force on the brace multiplied by 0.8 for Zone 3, 0.5 for Zone 2A, 0.6 for Zone 2B, or 0.3 for Zone 1.

NOTE: Bracing shall consist of at least one vertical angle 50 x 50 mm x 16 gauge and one diagonal angle of the same size.

3.8.3 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 12 m intervals except when the location of sway braces is shown on the drawings for the particular piping system. All runs shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with TM 5-809-10. Branch lines, walls, or floors shall not be used as sway braces.

3.8.4 Vertical Runs

Vertical runs of piping shall be braced at not more than 3 m vertical intervals. For tubing, bracing shall be provided at no more than 1.2 m spacing. Vertical braces shall be above the center of gravity of the span being braced. All sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.8.5 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip

angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.8.6 Maximum Length for Anchor Braces

Type	Size (millimeters)	Maximum Length* (meters)	Allowable Loads* (kilonewtons)
Angles	38 x 38 x 6	1.5	25.5
	50 x 50 x 6	2.0	34.5
	64 x 38 x 6	2.5	43.5
	75 x 64 x 6	2.5	48.0
	75 x 75 x 6	3.0	53.0
Rods	91	1.0	16.5
	22	1.0	22.0
Flat Bars	38 x 6	0.4	14.0
	50 x 6	0.4	18.0
	50 x 10	0.5	28.5
Pipes (40s)	25	2.0	18.0
	32	2.8	24.5
	40	3.2	29.5
	50	4.0	39.5

*Based on the slenderness ratio of l/r = 200 and ASTM A 36 steel, where l is the length of the brace and r is the least radius of gyration of the brace.

3.8.7 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation the same as required for piping in hangers.

3.8.8 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 13 mm diameter.

3.9 SWAY BRACES FOR DUCTS

3.9.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA-12, including Appendix E, using Seismic Hazard Level C.

3.9.2 Unbraced Ducts

Hangers for unbraced ducts shall be positively attached to the duct within 50 mm of the top of the duct with a minimum of two #10 sheet metal screws. Unbraced ducts shall be installed with a 150 mm minimum clearance to vertical ceiling hanger wires.

3.10 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe.

3.11 EQUIPMENT SWAY BRACING

3.11.1 Suspended Equipment

Equipment sway bracing shall be provided for items supported from overhead floor or roof structures. Braces shall consist of angles, rods, wire rope, bars, or pipes and secured at both ends with not less than13 mm bolts. Braces shall conform to paragraph Maximum Length for Anchor Braces. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 0.33 times the weight of equipment without exceeding safe working stress of bracing components. Details of equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.11.2 Floor or Pad Mounted Equipment

3.11.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

3.11.2.2 Overturning Resistance

The ratio of the height of the equipment (measured from the base to the center of gravity of the equipment) to the minimum distance between anchor bolts shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. If this ratio is greater than 8.89 the bolt values in paragraph Minimum Bolt Sizes, Cast-In-Place Anchor Bolts shall not be used and calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

3.12 MISCELLANEOUS EQUIPMENT

3.12.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand a horizontal lateral force of 0.07 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.

Rigidly Mounted Equipment

Boilers
Chillers
Air-Handling Units

Rigidly Mounted Equipment

Engine-Generators
Substations
Transformers
Switch Boards and Switch Gears
Motor Control Centers
Free Standing Electric Motors
Surge Tanks

3.12.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 0.130 times the operating weight of the equipment at the vertical center of gravity of the equipment.

Infrared heaters
Makeup air units
Unit heaters
Return fans

3.13 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.13.1 Pendant Fixtures

Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.

3.13.2 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system and shall be fastened thereto at each corner of the fixture with bolts or approved clips; or shall be provided with fixture support wires attached to the building structural members using two wires for individual fixtures, attached to opposite corners, and one wire per unit of continuous row mounted fixtures. Each wire support shall be capable of supporting four times the weight of the fixture. Recessed lighting fixtures not over 25 kg in weight and suspended or pendant-hung fixtures not over 10 kg in weight may be supported by and attached directly to the ceiling system runners by a positive attachment such as screws or bolts, number and size as required by design seismic zone. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

3.13.3 Assembly Mounted on Outlet Box

A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 100 mm boxes, 75 mm plaster rings, and fixture studs.

3.13.4 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissor clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixture.

3.13.5 Wall-Mounted Emergency Light Unit

Each wall-mounted emergency light unit shall be secured to remain in place during a seismic disturbance.

3.13.6 Lateral Force

Light fixture bracing shall be designed to resist a lateral force of 0.33 times the fixture weight.

3.14 SUSPENDED CEILING ASSEMBLIES

The structural members of ceiling support systems, used primarily to support acoustical tile panels or acoustical panel lay-in tiles, with or without lighting fixtures, ceiling-mounted air terminals, and ceiling-mounted services, shall conform to the following:

3.14.1 Design Loads

The main runners and cross-runners and their splices and intersection connections shall be designed for two times the design load or ultimate axial tension or compression (minimum 550 N. The connections at the splices and intersections shall be of a mechanical interlocking type that cannot easily be disengaged. Ceiling structural systems shall be designed to withstand required vertical load as well as a lateral force of 11.3 percent of the ceiling weight. The ceiling weight shall include all lighting fixtures and other equipment that are laterally supported by the ceiling and shall be not less than 200 Pa. Exception: Ceiling areas of 13 square meters or less surrounded by walls that connect directly to the structure above will be exempt from the lateral-load standards of this specification.

3.14.2 Installation Requirements

Installation requirements shall be in accordance with ASTM E 580 except as follows:

3.14.2.1 Vertical Support

Hanger wires supporting a maximum tributary ceiling area of 1.5 square meters shall be a minimum of 10 gauge in diameter. The size of wires supporting a tributary ceiling area greater than 1.5 square meters shall be substantiated by design calculations. Hanger attachment devices used in ceiling systems not exceeding 200 Pa shall be capable of supporting a minimum allowable load of 1.3 kN. Hanger attachment devices used in ceiling systems exceeding 200 Pa shall be capable of supporting the design load and shall be substantiated by design calculations. If hangers must be splayed more than one horizontal to six vertical, the resulting horizontal force shall be offset by bracing or counter-splaying, and substantiated by design calculations.

3.14.2.2 Lateral Support

In lieu of the design criteria stated above, where ceiling loads do not exceed 200 Pa, lateral support for the ceiling system may be provided by four galvanized wires of minimum No. 12 gauge, as indicated in ASTM E 580, paragraph 4.4.6.

3.14.3 Lighting Fixture and Air Diffuser Supports

Lighting fixture and air diffuser supports shall be designed and installed to meet the requirements of equipment supports in the preceding paragraphs of this specification with the following exceptions:

a. Recessed lighting fixtures not over 25 kg in weight and suspended and pendent-hung fixtures not over 10 kg in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws or bolts.

b. Air diffusers that weigh not more than 10 kg and that receive no tributary loading from ductwork may be positively attached to and supported by the ceiling runners.

3.15 BRIDGE CRANES AND MONORAILS

Bridges cranes and monorails shall be designed to accommodate the following horizontal lateral force coefficient of 0.13 times weight, applied in any direction to the center of gravity of the equipment. The weight of such equipment need not include any live load, and the equivalent static force so computed will be assumed to act nonconcurrently with other prescribed nonseismic horizontal forces when considering the design of the crane and monorails. The crane design shall be suitable for the forces previously specified in addition to the normal horizontal loads prescribed by standards cited in other sections of these specifications.

-- End of Section --

SECTION 13120

STANDARD METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA SAS-30	(1986) Aluminum Construction Manual Series - Section 1 Specifications for Aluminum Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD-90	(1990) AISC Quality Certification Program Description
AISC-S303	(1992) Code of Standard Practice for Steel Buildings and Bridges
AISC-S329	(1986) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts
AISC-S335	(1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673	(1987) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1994a) Carbon Structural Steel
ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 252	(1993) Welded and Seamless Steel Pipe Piles
ASTM A 325	(1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 446	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts,

	150 ksi Minimum Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1993) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 529	(1994) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 570	(1992; R 1993) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572	(1994b) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1991a; R 1993) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607	(1992a) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 618	(1993) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 792	(1993a) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements
ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1993) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 241	(1995) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 308	(1995) Aluminum-Alloy 6061-T6 Standard Structural Shapes
ASTM B 429	(1992a) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 553	(1992) Mineral Fiber Blanket Thermal

	Insulation for Commercial and Industrial Applications
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM D 4397	(1991) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	(1994a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1994) Water Vapor Transmission of Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel

MATERIAL HANDLING INSTITUTE (MHI)

MHI CMAA 70	(1994) Electric Overhead Traveling Cranes

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA-01	(1986; Errata; Supple 1990) Low Rise Building Systems Manual

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-1013	(1993) Architectural Sheet Metal Manual

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames

1.2 GENERAL

1.2.1 Building Configuration

Buildings shall have vertical walls and gable roofs. Roof slope shall be as indicated. Buildings shall be single-span structures with one of the following framing systems: rigid frame (tapered beam or plate girder). Building dimensions shall be as standard with the manufacturer and not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of the finished floor to the intersection of the insides of the roof and sidewall sheets. The clear opening between the finished floor and the bottom of the roof steel shall be as indicated.

1.2.2 Manufacturer

Metal building shall be the product of a recognized metal building systems manufacturer who has been in the practice of manufacturing metal buildings for a period of no less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating metal building systems. The manufacturer shall have an AISC Quality Certification, category MB in accordance with AISC FCD-90.

1.2.3 Installer

Erector shall have specialized experience in the erection of metal building systems for a period of at least 3 years.

1.3 DESIGN REQUIREMENTS

1.3.1 Design Conditions

Loading combinations and definitions shall be in accordance with MBMA-01. Loading criteria as set out by MBMA-01 shall apply.

1.3.1.1 Dead Load

The dead load shall consist of the weight of the structural frame and all other materials of the building system.

1.3.1.2 Collateral Loads

Collateral load of 480 Pa shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 25 kg or more. Equipment loads of 25 kg or more shall be investigated and the structure (frame, purlins, girts) shall be strengthened as required. The Contractor is responsible for providing the building manufacturer the magnitude and approximate location of all concentrated loads greater than 25 kg.

1.3.1.3 Roof Live Loads

Roof live loads shall be determined and applied in accordance with MBMA-01.

1.3.1.4 Roof Snow Loads

The design roof snow loads shall be as shown on the contract drawings.

1.3.1.5 Wind Loads

Wind pressures shall be computed and applied in accordance with MBMA-01 unless otherwise shown or directed by the Contracting Officer.

1.3.1.6 Auxiliary Loads

Auxiliary (dynamic live) loads such as superimposed loads resulting from building machinery, craneways, and vehicles shall be as shown in the drawings. The Contractor shall verify that the auxiliary loads shown on the drawings exceed the loads imposed by the equipment supplied.

1.3.1.7 Concentrated Loads

Concentrated loads shall be applied at locations indicated on the drawings.

1.3.1.8 Seismic Loads

Seismic loads shall be computed for seismic zone 1 in accordance with MBMA-01 using an importance factor of 1.15.

1.3.2 Foundation Requirements

Foundations shall be designed for an allowable soil bearing pressure of 120 kPa, a minimum bottom of footing depth of 600 mm below finish floor elevation, a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

1.3.3 Framing and Structural Members

Structural steel members and their connections shall be designed in accordance with AISC-S335. Structural cold-formed steel framing members and their connections shall be designed in accordance with AISI SG-673. Aluminum structural members and their connections shall be designed in accordance with AA SAS-30. Framed openings shall be designed to structurally replace the covering and framing displaced. The allowable live load deflection of roof elements shall not exceed 1/180th of the span. Members with openings in their webs shall be designed with consideration of the additional stresses which will result due to the openings. Deflections of the steel framing above and along the side of rolling door openings shall be limited to a maximum of 1/2 of the allowable movement in the telescoping top roller of the doors to ensure proper operation of the doors.

1.3.4 Exterior Covering

Except as otherwise specified, steel covering shall be designed in accordance with AISI SG-673. Maximum deflection for wall and roof panels under full dead and live and/or wind loads shall not exceed 1/180th of the span between supports. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition to the loads indicated above, the roof decking shall be designed for a 900 N concentrated load at midspan on a 305 mm wide section of deck. The methods for resisting lateral loads shall be cross-bracing, rigid frames, or wind columns.

1.3.5 Gutters And Downspouts

Gutters and downspouts shall be designed according to the requirements of SMACNA-1013 for storms which should be exceeded only once in 5 years and with adequate provisions for thermal expansion and contraction. Supports for gutters and downspouts shall be designed for the anticipated loads.

1.3.6 NOT USED

1.3.7 Ventilators

1.3.7.1 NOT USED

1.3.7.2 Continuous Ventilators

Continuous roof ventilators shall be ridge mounted gravity type, with dampers, designed for a minimum capacity of 0.0793 cubic meters of air per second for each 3 m section based on a wind velocity of 8 km per hour and an exterior-interior temperature differential of 6 degrees C and without screens in place.

1.3.8 Drift Provision

Lateral deflections, or drift at the roof level of a structure in relation to the floor or slab on grade, caused by deflection of horizontal force resisting elements shall conform to MBMA-01.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

Data

Design Analysis

Design analysis as one package with the detail drawings. The design analysis signed by a Registered Professional Engineer shall include a list of the design loads, and complete calculations for the building, its components, and the foundations. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. The design analysis shall include, but not be limited to, the following wind and seismic information:

a. Wind forces on various parts of the structure. Both positive and negative pressures shall be calculated with the controlling pressure summarized.

b. Lateral forces due to seismic loading.

Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a Registered Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included in the submittal. The program output shall be annotated and supplemented with sketches to make it easier for an engineer unfamiliar with the program to verify the input and output. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer and checker who function as a point of contact to answer questions during the detail-drawing review.

Drawings

Metal Building Systems

Detail drawings consisting of catalog cuts, design and erection drawings containing an isometric view of the roof showing the design wind uplift pressure and dimensions of edge and corner zones; shop painting and finishing specifications, instruction manuals, manufacturer's recommended erection methods and procedures and other data as necessary to clearly describe design, material, sizes, layouts, construction details, fasteners, and erection. Manufacturer's recommended erection methods and procedures shall describe the basic sequence of assembly, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall include information regarding date of installation, name and address of owner, and how the structure is used.

Statements

Qualifications

Qualifications of the manufacturer, and qualifications and experience of the building erector.

Certificates

Metal Building Systems

A Certificate from the metal building manufacturer stating that the metal building was designed from a complete set of the contract drawings and specifications and that the building furnished complies with the specified requirements.

Mill certification for structural bolts, framing steel, wall and roof covering, and wall liner panels.

Insulation

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weathertight coverings and kept dry. Storage accommodations for roof and wall covering shall provide good air circulation and protection from surface staining.

1.6 GUARANTEE

The metal building system shall be guaranteed against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 20 years. Such guarantee shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

PART 2 PRODUCTS

2.1 BUILDING COMPONENTS

Each piece or part of the assembly shall be clearly and legibly marked to correspond with the detail drawings.

2.2 FRAMING AND STRUCTURAL MEMBERS

Steel 3.2 mm or more in thickness shall conform to ASTM A 36, ASTM A 529, ASTM A 572, or ASTM A 588. Uncoated steel less than 3.2 mm in thickness shall conform to ASTM A 570, ASTM A 606, or ASTM A 607. Galvanized steel shall conform to ASTM A 446, G 90 coating designation, 1.143 mm minimum thickness. Aluminum-zinc coated steel shall conform to ASTM A 792, AZ 55 coating designation, 1.143 mm minimum thickness. Aluminum sheet shall conform to ASTM B 209, 0.813 mm minimum thickness. Aluminum structural shapes and tubes shall conform to ASTM B 221, or ASTM B 308. Structural pipe shall conform to ASTM A 53, ASTM A 252, ASTM A 500, ASTM A 501, ASTM A

618, ASTM B 221, ASTM B 241 or ASTM B 429. Holes for bolts shall be made in the shop.

2.3 ROOF AND WALL COVERING

Refer to Section 07416-STANDING SEAM METAL ROOF SYSTEM for roof panels for standard metal buildings.

Refer to Section 07416-STANDING SEAM METAL ROOF SYSTEM for fascia (wall) panels for standard metal buildings. Roof panels shall be structural and shall be designed to span from purlin to purlin at spacings required by pre-engineered metal building manufacturer.

2.3.1 NOT USED

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 NOT USED

2.3.5 NOT USED

2.3.6 NOT USED

2.3.7 Accessories

Flashing, trim, metal closure strips and curbs, fascia, caps, diverters, and similar metal accessories shall be not less than the minimum thickness specified for covering. Accessories shall be compatible with the system furnished. Exposed metal accessories shall be finished to match the building covering finish. Molded closure strips shall be closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering and shall not absorb or retain water.

2.4 FASTENERS

Refer to Section 07416-STANDING SEAM METAL ROOF SYSTEM.

2.5 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be fabricated of zinc-coated steel or aluminum-zinc alloy coated steel and shall have manufacturer's standard factory color finish. Minimum uncoated thickness of materials shall be 0.455 mm for steel. All accessories necessary for the complete installation of the gutters and downspouts shall be furnished. Accessories shall include gutter straps, downspout elbows, downspout straps and fasteners fabricated from metal compatible with the gutters and downspouts.

2.6 NOT USED

2.7 NOT USED

2.8 CONTINUOUS ROOF VENTILATORS

Continuous roof ventilators shall be fabricated of zinc-coated steel, or aluminum-zinc alloy coated steel, shall have manufacturer's standard factory color finish, and shall be furnished with bird and insect screens and chain or cable operated dampers. Minimum uncoated thickness of

materials shall be 0.455 mm for steel. Ventilators shall be furnished in 2.44 to 3.05 m long sections braced at midlength.

2.9 NOT USED

2.10 NOT USED

2.11 DOORS

2.11.1 Hinged Doors

Hinged doors and frames shall conform to SDOI SDI-100, Type, Grade and size as indicated and the requirements of Section 08111 STANDARD STEEL DOORS, and 08112 STANDARD STEEL FRAMES. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as specified in Section 08710 DOOR HARDWARE.

2.11.2 NOT USED

2.11.3 Overhead Doors

Overhead doors shall be industrial type of standard manufacture, fabricated of 0.864 mm or heavier galvanized or aluminum-zinc alloy coated steel. All hardware necessary for the complete installation of the doors shall be furnished. Accessories shall include galvanized steel track, brackets, lifting handles, torsion-spring mechanism, ball bearing rollers, cylinder lock, and weatherstripping. Doors shall be manually operated, except doors over 13.4 square meters in area shall be electric motor operated.

2.12 NOT USED

2.13 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 24 degrees C (75 degrees F) in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. Insulation, including facings, shall have a flame spread not in excess of 75 and a smoke developed rating not in excess of 150 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

2.13.1 NOT USED

2.13.1.1 NOT USED

2.13.1.2 Mineral Fiber

Insulation shall conform to ASTM C 612.

2.13.2 Blanket Insulation

Blanket insulation shall conform to ASTM C 553.

2.13.3 NOT USED

2.13.4 Insulation Retainers

Retainers shall be type, size and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

2.14 WALL LINERS

Wall liners shall be 0.455 mm thick minimum for steel of composition specified for covering, and formed or patterned to prevent waviness and distortion, and shall extend from the floor to the underside of the roof. Matching metal trim shall be provided at base of wall liner, top of wall liner, and around openings in walls and roof and over interior and exterior corners. Wall liners shall have a factory color finish of the quality specified for the roof and wall panels. Colors shall be selected from manufacturer's standard finishes. Refer to Section 07465-PREFORMED METAL WALL PANELS.

2.15 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be clear and shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

2.16 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.17 VAPOR RETARDER

2.17.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 1.0 ng per Pa-second-square meter or less when tested in accordance with ASTM E 96. Facing shall be white of reinforced foil with a vinyl finish. Facings and finishes shall be factory applied.

2.17.2 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to the requirements of ASTM D 4397. A single ply of 0.25 mm polyethylene sheet; or, at the option of the Contractor, a double ply of 0.15 mm polyethylene sheet shall be used. A fully compatible polyethylene tape shall be provided which has equal or better water vapor control characteristics than the vapor retarder material. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

2.17.3 Slip Sheet for Use With Vapor Retarder

Slip sheet for use with vapor retarder shall be a 0.24 kg per square meter rosin-sized, unsaturated building paper.

2.18 SHOP PRIMING

Ferrous surfaces shall be cleaned of oil, grease, loose rust, loose mill scale, and other foreign substances and shop primed. Primer coating shall be in accordance with the manufacturer's standard system.

PART 3 EXECUTION

3.1 ERECTION

3.1.1 General

Erection shall be in accordance with the approved erection instructions and drawings and with applicable provision of AISC-S335. The completed buildings shall be free of excessive noise from wind-induced vibrations under the ordinary weather conditions to be encountered at the location where the building is erected, and meet all specified design requirements. Dissimilar materials which are not compatible when contacting each other shall be insulated from each other by means of gaskets or insulating compounds. Framing members fabricated or modified on site shall be saw or abrasive cut; bolt holes shall be drilled. On-site flame cutting of framing members, with the exception of small access holes in structural beam or column webs, shall not be permitted. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Improper or mislocated bolt holes in structural members or other misfits caused by improper fabrication or erection, shall be repaired in accordance with AISC-S303. Exposed surfaces shall be kept clean and free from sealant, metal cuttings, excess material from thermal cutting, and other foreign materials. Exposed surfaces which have been thermally cut shall be finished smooth within a tolerance of 3.2 mm. Stained, discolored or damaged sheets shall be removed from the site. Welding of steel shall conform to AWS D1.1. High-strength bolting shall conform to AISC-S329 using ASTM A 325 or ASTM A 490 bolts. Concrete work is specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

3.1.2 Framing and Structural Members

Anchor bolts shall be accurately set by template while the concrete is in a plastic state. Uniform bearing under base plates and sill members shall be provided using a nonshrinking grout when necessary. Members shall be accurately spaced to assure proper fitting of covering. Separate leveling plates under column base plates shall not be used. As erection progresses, the work shall be securely fastened to resist the dead load and wind and erection stresses. Supports for electric overhead traveling cranes shall be positioned and aligned in accordance with MHI CMAA 70.

3.1.3 Wall Covering and Roof Covering

Wall covering shall be applied with the longitudinal configurations in the vertical position. Roof covering shall be applied with the longitudinal configurations in the direction of the roof slope. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction. Vertical seams of metal fascia panels shall align with seams of metal roof panels.

3.1.3.1 Lap Type Panels with Exposed Fasteners

Except for self-framing buildings, end laps shall be made over framing members with fasteners into framing members approximately 50 mm from the end of the overlapping sheet. Side laps shall be laid away from the prevailing winds. Side lap distances, end lap distances, joint sealing, and spacing and fastening of fasteners shall be in accordance with the manufacturer's standard practice insofar as the maximum spacings specified are not exceeded and provided such standard practice will result in a structure which will be free from water leaks and meet design requirements. Side laps and end laps of roof and wall covering and joints at accessories shall be sealed. Fasteners shall be installed in straight lines within a tolerance of 15 mm in the length of a bay. Fasteners shall be driven normal to the surface and to a uniform depth to properly seat the gasketed washers.

3.1.3.2 Concealed Fastener Wall Panels

Panels shall be fastened to framing members with concealed fastening clips or other concealed devices standard with the manufacturer. Spacing of fastening clips and fasteners shall be in accordance with the manufacturer's written instructions insofar as the maximum fastener spacings specified are not exceeded and provided such standard practice will result in a structure which will be free from water leaks and meet design requirements. Spacing of fasteners and anchor clips along the panel interlocking ribs shall not exceed 300 mm on center except when otherwise approved. Fasteners shall not puncture covering sheets except as approved for flashing, closures, and trim; exposed fasteners shall be installed in straight lines. Interlocking ribs shall be sealed according to manufacturer's recommendations. Joints at accessories shall be sealed.

3.1.4 Gutters and Downspouts

Gutters and downspouts shall be rigidly attached to the building. Spacing of cleats for gutters shall be 400 mm maximum. Spacing of brackets and spacers for gutters shall be 1 m maximum. Supports for downspouts shall be spaced according to manufacturer's recommendations.

3.1.5 Ventilators

Ventilators shall be rigidly attached to the supporting construction in a manner to assure a rain-tight installation.

3.1.6 Doors

Doors, including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true, and shall be adjusted as necessary to provide proper operation. Joints at doors shall be sealed according to manufacturer's recommendations to provide weathertight construction.

3.1.7 Insulation Installation

Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

3.1.7.1 Board Insulation with Blanket Insulation

Rigid or semirigid board insulation shall be laid in close contact. If more than one layer of insulation is required, joints in the second layer shall be offset from joints in the first layer. A layer of blanket

insulation shall be placed over the rigid or semirigid board insulation to be compressed against the underside of the metal roofing to reduce thermal bridging, dampen noise, and prevent roofing flutter. This layer of blanket insulation shall be compressed a minimum of 50 percent.

3.1.7.2 Blanket Insulation

Blanket insulation shall be installed over the purlins and held tight against the metal roofing. It shall be supported by an integral facing or other commercially available support system.

3.1.8 Protection of Vapor Retarder from Roof Deck

A cloth industrial duct tape shall be adhered over all the seams of metal roof purlins, at any penetration edges, and at all surface areas exhibiting sharp burrs or similar protrusions. For other types of roof decking, cloth industrial duct tape shall be adhered over all irregularities which could potentially puncture polyethylene membrane.

3.1.9 Vapor Retarder Installation

3.1.9.1 Integral Facing on Blanket Insulation

Integral facing on blanket insulation shall have the facing lapped and sealed with a compatible tape to provide a vapor tight membrane.

3.1.9.2 Polyethylene Vapor Retarder

The polyethylene vapor retarder membrane shall be installed over the entire surface. A fully compatible polyethylene tape shall be used to seal the edges of the sheets to provide a vapor tight membrane. Sheet edges shall be lapped not less than 150 mm. Sufficient material shall be provided to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with polyethylene tape.

3.1.10 Slip Sheet Installation

A slip sheet shall be laid over the blanket insulation facing to prevent the vinyl facing from adhering to the metal roofing.

3.1.11 Wall Liner

Wall liner shall be securely fastened into place in accordance with the manufacturer's recommendation and in a manner to present a neat appearance.

3.2 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows shall be painted with two coats of an approved exterior enamel. Factory color finished surfaces shall be touched up as necessary with the manufacturer's recommended touch-up paint.

-- End of Section --

SECTION 14630

OVERHEAD ELECTRIC CRANES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 390.03a	(1980; Errata 1983) Gear Handbook Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears
AGMA 2001-B	(1995) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
AGMA 6010-E	(1988; Errata Nov 91) Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives
AGMA 6019-E	(1989) Gearmotors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 159	(1983; R 1993) Automotive Gray Iron Castings
ASTM A 325	(1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 668	(1995) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM B 438	(1995a) Sintered Bronze Bearings (Oil-Impregnated)
ASTM B 439	(1995) Iron-Base Sintered Bearings (Oil-Impregnated)
ASTM B 612	(1991) Iron Bronze Sintered Bearings (Oil-Impregnated)
ASTM B 633	(1985; R 1994) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E 125	(1963; R 1993) Magnetic Particle

Indications on Ferrous Castings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.2	(1990; B30.2a; B30.2b; B30.2c; B30.2d) Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
ASME B30.16	(1993; B30.16a; B30.16b; B30.16c)Overhead Hoist (Underhung)
ASME B30.17	(1992; Errata; Sep 1993; B30.17a; B30.17b; B30.17c) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
ASME HST-1M	(1989; R 1995) Electric Chain Hoists

AMERICAN WELDING SOCIETY (AWS)

AWS D14.1	(1985) Welding of Industrial and Mill Cranes and Other Material Handling Equipment

MATERIAL HANDLING INSTITUTE (MHI)

MHI CMAA 70	(1994) Electric Overhead Traveling Cranes
MHI CMAA 74	(1994) Top Running & Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems, Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA MG 1	(1993; Rev 1; Rev 2) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50	(1995; Rev Oct 1996) Enclosures for Electrical Equipment
UL 489	(1996) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 943	(1993; Rev thru Sep 1996)Ground-Fault Circuit-Interrupters

UL 1449 (1985; Errata Apr 1986) Transient Voltage Surge Suppressors

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Overhead Crane System; GA.

A complete list of equipment and materials, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions.

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Overhead Crane System; GA.

Detail drawings containing complete wiring and schematic diagrams. Diagrams shall indicate each numbered wire, where wire initiates, where wire terminates, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-06 Instructions

Framed Instructions GA.

Diagrams, instructions and safety requirements.

SD-09 Reports

Acceptance Testing; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The report shall include the information as required by paragraph ACCEPTANCE TESTING.

SD-18 Records

Hooks; FIO.

Hook material and any heat treatment performed, stamped on the hook shank or documented in certification papers furnished with the hooks. Crane test data recorded on appropriate test record forms suitable for retention for the life of the crane.

SD-19 Operation and Maintenance Manuals

Overhead Crane System; GA.

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to the field training course.

1.3 QUALIFICATION

Electric overhead cranes shall be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents.

1.4 TESTING AND INSPECTIONS

1.4.1 Pre-Delivery Inspections

Contractor shall be responsible for performance of quality control inspections, testing and documentation of steel castings, hook assembly and nuclear safety as follows.

1.4.2 Inspection of Steel Castings

Load-carrying steel castings shall be visually inspected and tested using the magnetic-particle inspection method. Allowable degree of discontinuities shall be referenced to ASTM E 125, and shall be related to service loads and stresses, critical configuration, location and type. Methods of repairing the discontinuities shall be subject to review by the Contracting Officer.

1.4.3 Inspection of Hook Assembly

Hook and nut shall be inspected by a magnetic-particle type inspection or X-rayed prior to delivery. Documentation of hook inspection shall be furnished to Contracting Officer at the field operational testing. As part of the acceptance standard, linear indications will not be allowed. Welding repairs of hook will not be permitted. A hook showing linear indications, damage or deformation will not be accepted, and shall be replaced.

1.5 DESIGN CRITERIA

Cranes shall operate in the given spaces and shall match the runway dimensions and rails indicated. Hook coverage, hook vertical travel, clear

hook height, lifting capacity, and load test weight shall not be less than that indicated.

1.5.1 General

The hoisting equipment shall include the following:

Number of cranes; 1, located in building name; Aviation Support Facility, with a number of metric tons; 3.63, electric overhead traveling crane. The Contractor shall assure that the manufacturer supplying the hoist equipment in Section [_____] is also the manufacturer supplying the hoist equipment in this section.

1.5.2 Classification

Crane shall be designed and constructed to MHI CMAA 70 Class C, moderate service requirements for operation in non-hazardous environment with hoist in accordance with ASME HST-1M.

1.5.3 Rated Capacity and Speeds

Rated capacity of crane shall be 3.63 metric tons. Lower load block or assembly of hook, swivel bearing sheaves, pins and frame suspended by the hoisting ropes shall not be considered part of the rated capacity. Rated speeds (in meters per second) for the hoist, hoist micro-drive, bridge micro-drive, trolley micro-drive, bridge and trolley at the rated load shall be as follows:

	Rated Speeds		
Description	Minimum	Maximum	Micro-drive
Main Hoist	0.10	0.25	0.005
Trolley	0.25	0.51	0.005
Bridge	0.51	0.89	0.005

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.7 FIELD MEASUREMENTS

Before performing any work, Contractor shall become familiar with all details of the work, verify all dimensions in the field, and submit a letter describing the results of this verification including discrepancies to the Contracting Officer and crane manufacture.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

Materials and equipment shall be standard products of manufacturers regularly engaged in the fabrication of complete and totally functional cranes including necessary ancillary equipment.

2.1.2 Nameplates

Nameplates shall be secured to each major component of equipment with the manufacturer's name, address, type or style, model or catalog number, and serial number. Two bridge identification plates shall be provided, one for each side of bridge.

2.1.3 Use of Asbestos Products

Materials and products required for designing and manufacturing cranes shall not contain asbestos.

2.1.4 Capacity Plates

Two capacity plates indicating the crane capacity in metric tons and tons are required, one secured to each side of bridge. Each capacity plate shall be fabricated of a steel backing plate and exterior quality/fade-resistant stick-on labels with letters large enough to be easily read from the floor. Capacity plates shall be placed in a location visible to operator's position after the crane has been installed.

2.1.5 Safety Warnings

Readable warning labels shall be affixed to each lift block or control pendant in a readable position in accordance with ASME B30.16, ASME B30.2 and ASME B30.17. The word "WARNING" or other legend shall be designed to bring the label to the attention of the operator. Warning labels shall be durable type and display the following information concerning safe-operating procedures: Cautionary language against lifting more than the rated load; operating the hoist when the hook is not centered under the hoist; operating hoist with twisted, kinked or damaged rope; operating damaged or malfunctioning hoist; operating a rope hoist with a rope that is not properly seated in its hoist drum groove; lifting people; lifting loads over people; and removing or obscuring the warning label.

2.1.5.1 Directional Arrows

To avoid operation of crane in the wrong direction, the words "FORWARD" and "REVERSE" and accompanying directional arrows shall be affixed in a location on the trolley and bridge which are visible and readable to the operator. The words "FORWARD" and "REVERSE" shall agree with the markings on control. Directional arrows shall not be indicated on control.

2.2 STRUCTURAL MATERIALS

2.2.1 Bolts, Nuts and Washers

High-strength bolted connections shall utilize SAE Grade 5 bolts with corresponding lockwashers, nuts, etc., conforming to requirements of AISC-S329 bolts. Bolts, nuts and washers shall conform to ASTM A 325 bolts. Galvanized bolts are not acceptable.

2.2.2 Bridge Girders or Girders

Bridge girders shall be wide flange beams, standard I-Beams, reinforced beams or sections fabricated from rolled plates and shapes.

2.2.3 NOT USED

2.2.4 End Ties and Bridge Girder End Connections

Welded steel box sections shall be used for end ties, full depth diaphragms shall be provided at girder connections and jacking points. Horizontal gusset plates shall be provided at the elevation of top and bottom end tie flanges for connection to girder ends. End connections shall be made with high-strength bolts. Body-bound bolts fitted in drilled and reamed holes shall be used to maintain the crane square.

2.2.5 Bridge End Trucks

End trucks shall be the rotating or fixed axle type fabricated of structural tubes or from structural steel to provide a rigid box section structure. Jacking pads shall be provided for removal of wheel assemblies.

2.2.6 Trolley Frame

Trolley frame shall consist of two structural steel side frames or trucks welded together with one or more structural steel load girts to form a one-piece unit. Pads shall be provided for the use of jacks or wedges when changing truck wheels. All trolley yokes and load bars shall be of drop forged, cast or rolled steel.

2.2.7 Stops and Bumpers

Crane runways and bridge girders shall be fitted with structural steel end stops. Bridge end trucks and trolley frames shall be fitted with shock-absorbing, spring or hydraulic type bumpers capable of decelerating and stopping the bridge and/or trolley within the limits stated by OSHA and MHI CMAA. Trolley end stops shall be of sufficient strength to withstand the impact of a fully loaded trolley moving at 50 percent of maximum rated travel speed. Bridge bumper stops shall be provided as specified in Section 05120 STRUCTURAL STEEL.

2.3 MECHANICAL EQUIPMENT

2.3.1 Drives

2.3.1.1 Bridge Drives

Bridge drives shall be A-4 drive arrangement as specified in MHI CMAA 70 or MHI CMAA 74. Bridge drive shall consist of a single electric motor mechanically connected through gear reduction and drive shafts to the drive wheels or separate drive motors at each runway. Acceleration and deceleration shall meet the requirements specified in this section. Gears shall conform to applicable AGMA standards. Gear reducers shall be oil tight and fully enclosed with pressure or splash type lubrication. Bridge-travel limit-switches are optional.

2.3.1.2 Trolley Drives

Trolley shall be complete with a drive arrangement with a minimum of two wheels driven by an integral electric motor. Drive mechanism shall run in totally enclosed oil bath. Limit switches are optional for drive mechanism. Acceleration and deceleration controls shall meet requirements specified in this section.

2.3.1.3 Micro-Drives

The following crane motions shall be provided with a separate micro-drive: main hoist, trolley drive and bridge drive. The micro-drives shall be used to precisely position loads. Each micro-drive shall consist of an electric motor, gear reducer, magnetic coupling clutch and necessary controls. The output shaft of the reducer shall be connected to an extension of the primary drive high-speed shafting with a magnetic coupling clutch. Coupling shall normally be disengaged and shall be engaged only if the micro-drive is required. Electrical clutch components required for proper operation shall conform to the requirements specified in paragraph ELECTRICAL COMPONENTS. Clutches shall be the magnetic coupling type, and shall engage and disengage the micro-drives from the high speed shafts of the main drive arrangement. The clutch shall be engaged by electromagnet and released by springs. Clutch ratings shall be not less than 150 percent of the micro-motor rated torque as amplified by the intervening gearing. Clutch enclosures shall facilitate easy access for wear inspection of the friction elements and visual examination of the clutch assemblies.

2.3.2 Load Blocks

2.3.2.1 Main and Auxiliary Hoist Load Blocks

Load blocks shall be of welded steel construction. Load blocks shall be provided with hot-rolled or forged steel fixed crosshead separate from the sheave pin with swivel mounting for forged steel hook. Each lubrication fitting for sheave pins shall be an independent type recessed within the sheave pin or adequately guarded to prevent damage. The pitch diameter of the sheaves shall be not less than 16 times the rope diameter. Sheaves shall be supported by roller type bearings on steel sheave pins. Provisions for external lubrication shall be provided to allow pressure relief and purging of old grease. Sheave blocks shall be constructed to provide maximum personnel safety and to prevent the hoist rope from leaving the sheaves under normal operating condition.

2.3.2.2 Hook Assembly

Hooks shall be single barbed and shall be made of forged steel complying with ASTM A 668. Hook dimensions shall be as shown. Hooks shall be fitted with safety latches designed to preclude inadvertent displacement of slings from the hook saddle. Painting or welding shall not be performed on the hook. Hook nut shall be secured with a removable type set screw or other similar fastener, but shall not be welded. Hooks shall be designed and commercially rated with safety factors in accordance with MHI CMAA. The hook shall be free to rotate through 360 degrees when supporting the rated load.

2.3.3 Hoisting Ropes

Hoisting ropes shall be regular lay, preformed, uncoated, improved plow steel, 6 by 37 construction, with independent wire rope core. Ropes shall be suited to meet the service requirements. Rope socketing or U-bolt clip connections shall be made in accordance with clip or rope manufacturer's recommendation, and shall be equal to or greater than the rope strength. Hoisting ropes shall be the rated capacity load plus the load block weight divided by the number of rope parts, and shall not exceed 20 percent of the certified breaking strength of rope. Hoisting ropes shall be secured to hoist drum so that no less than two wraps of rope remain at each anchorage of hoist drum at the extreme low position (limit switch stop).

2.3.4 Sheaves

Sheaves shall be of cast, forged, rolled, or welded structural steel. Sheave grooves shall be accurately machined, smoothly finished and free of surface defects.

2.3.5 Hoist Drums

Hoist drums shall be of welded rolled structural steel, cast steel, or seamless steel pipe. Diameter of drum shall be not less than 24 times the diameter of hoist cable. Drums shall be machined and provided with right-hand and left-hand grooves to take the full run of cable for the required lift without overlapping, plus a minimum of two full wraps of cable when load is on floor. At least one groove shall remain unused when hook is at the highest position. Drum grooves shall be cut from solid stock and have sufficient depth for size of cable required. Drum flanges shall be guarded so that the cable cannot wedge between drum flange and hoist frame.

2.3.6 Gearing

Gearing shall be of the enclosed gear reducers type. Gears and pinions shall be spur, helical, or herringbone type only, and shall be forged, cast or rolled steel; open-type gearing is not acceptable. Gears and pinions shall have adequate strength and durability for the crane service class and shall be manufactured to AGMA 2001-B Quality Class 6 or better precision per AGMA 390.03a.

2.3.6.1 Gear Reducers

Gear reducers shall be standard items of manufacturers regularly engaged in the design and manufacture of gear reducers for Class D and G cranes or shall be integral components of standard hoists or hoist/trolley units of manufacturers regularly engaged in the design and manufacture of hoists or hoist/trolley units for Class A, B or C cranes. Gear reducers shall be designed, manufactured and rated in accordance with AGMA 6010-E, AGMA 6019-E (for trolley drives only), as applicable. Except for final reduction, the gear reduction units shall be fully enclosed in oil-tight housing. Gearing shall be designed to AGMA standards and shall operate in an oil bath. Operation shall be smooth and quiet.

2.3.7 Brakes

Brakes shall be of the shoe or disc type with thermal capacity suitable for class and service specified in this section. Shoe and disc brakes shall be spring-set and electrically-released by a continuously rated direct acting magnet. Brakes shall be self-aligning and provide for easy adjustment for torque setting and lining wear. Brake lining material shall be asbestos free. Brake wheels shall be cast iron conforming to ASTM A 159 or shall be the manufacturer's standard high-strength ductile cast-iron, provided that the material exhibits wear characteristics in the form of powdered wear particles and is resistant to heat-checking. Disc brakes shall be totally enclosed and have multiple discs with stationary releasing magnets. Brake torque shall be easily adjustable over a 2:1 torque range.

2.3.7.1 Hoist Holding Brakes

Each hoist shall be equipped with at least 2 holding brakes. Holding brake shall be disc or shoe design, applied to one of the following: motor shaft or gear reducer shaft or rope drum. Braking system shall be designed to

have zero hook lowering motion when a raise motion is initiated. Primary brake shall be a spring-set, electrically-released, disc or shoe type brake. Brake shall have a minimum torque rating of 150 percent of motor torque. Brake shall be capable of holding the rated load with zero hook drift. Primary brake shall be automatically set when controls are released or when power is interrupted. Provisions shall be made to facilitate easy brake adjustment. Hoists shall be furnished with mechanical-control braking or a power-control braking system. Typical power means include dynamic lowering, eddy-current braking, counter-torque, regenerative braking, variable frequency, and adjustable or variable voltage.

2.3.7.2 Hoist Control Brake

Hoist shall be provided with electrically-controlled braking system to prevent overspeeding.

2.3.7.3 Trolley Brake

Trolley braking system shall be provided with spring-applied and electrically-released shoe brakes or disc brakes. Braking system shall be automatically set when controls are released or power is interrupted. Provisions shall be made to facilitate easy brake adjustment. Brakes shall have a torque rating of at least 50 percent of trolley drive motor rated torque.

2.3.7.4 Bridge Brakes

Bridge braking system shall be provided with a spring-applied and electrically-released single shoe or disc brake for each bridge drive motor. Braking system shall be automatically set when controls are released or power is interrupted. Provisions shall be made to facilitate easy brake adjustment. Brakes shall have a torque rating of at least 50 percent of bridge drive motor rated torque.

2.3.8 Wheels

Wheels shall be manufactured of rolled or forged steel. Wheel treads and flanges shall be rim toughened to between 320 and 370 Brinell hardness number. Trolley wheels shall have straight treads. Bridge wheels shall have straight treads. Wheels shall be equipped with self-aligning double-row spherical roller-bearings of capacity as recommended by bearing manufacturer for design load of trolley or bridge.

2.3.9 Bearings

Bearings shall be antifriction type, except bearings which are subject only to small rocker motion. Equalizer sheaves shall be equipped with sintered oil-impregnated type bushings in accordance with ASTM B 438, ASTM B 439, or ASTM B 612.

2.3.10 Anti-Drip Provisions

Cranes shall be designed to preclude leakage of lubricants onto the lifted loads or the floor. Equipment and components which cannot be made leak-proof shall be fitted with suitable drip pans. Drip pans shall be manufactured of steel and designed to permit removal of collected lubricant.

2.3.11 Lubrication System

Splash-type oil lubrication system shall be provided for hoist, trolley and bridge gear cases; an oil pump shall be used on vertical-mounted gear cases exceeding two reductions. Oil pumps shall be the reversible type capable of maintaining the same oil flow direction and volume while being driven in either direction. Electric motor-driven pumps may be used when input shaft speed is too low at any operating condition to ensure adequate oil flow. In such applications, pump shall be energized whenever drive mechanism brakes are released.

2.4 ELECTRICAL COMPONENTS

2.4.1 Explosion Proof Requirements

Equipment and wiring in locations indicated on drawings shall conform to NFPA 70 for Class I, Division 2 hazardous locations. Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature as indicated.

2.4.2 Control Systems

2.4.2.1 Hoist Control System

Main hoist motion control system shall be two speed, with ac magnetic control of ac squirrel cage motor. Control shall provide for reversing, and for a mechanical load brake.

2.4.2.2 Travel Control System

Bridge and trolley motion control system shall be two speed with ac magnetic control of squirrel cage motors.

2.4.2.3 Drive Control System

The main hoist, trolley and bridge micro-drive control systems shall be dc magnetic, single speed, reversing.

2.4.3 Power Sources

2.4.3.1 System Supply Voltage

Cranes shall be designed to be operated from a 480 volt, three-phase, 60 Hz, alternating current system power source. Energy isolating devices for such machine or equipment shall be designed to accept a lockout device in accordance with NFPA 70.

2.4.3.2 Transformers

Transformers shall be dry type suitable for the application.

2.4.3.3 Power Rectifiers

Power rectifiers shall be provided where required to convert ac to dc. Active semiconductor devices shall be silicon type. Rectifiers for motor control system shall be three-phase full wave rectifiers. Rectifiers for brakes shall be single-phase full-wave or three-phase full-wave rectifiers. A single rectifier may be used in lieu of several smaller rectifiers; brakes shall be supplied from a different rectifier than the other equipment. Protective enclosures shall conform to the requirements of NEMA ICS 6 Type [_____]. Rectifying elements shall be hermetically-sealed and

mounted on heat sinks cooled by natural convection or by mechanical means. Minimum protection for rectifiers shall consist of transient surge suppressors, and 100,000 AIC current-limiting 700V rectifier type fuses in the ac line. Minimum protection for main power rectifiers shall include a line isolation transformer of the type specifically designed for use with static conversion units. Individual diode sets and thyristors shall be protected by fuses on the ac side. Each rectifier bridge used in brake circuits (including overload protection) shall be rated for continuous-duty at a minimum of 150 percent of load rating, and for 1 minute at a minimum of 300 percent of load rating. Each rectifier or SCR bridge used in the dc constant potential control system or in dc variable voltage shall be rated for continuous-duty at a minimum of 100 percent of the load rating, and for one minute at a minimum of 200 percent of load rating following 8 hours at 100 percent load. The dc rated output voltage shall not exceed 460 volts.

2.4.4 Motors

2.4.4.1 General Requirements

Motors shall be designed specifically for crane and hoist duty. Drain holes shall be provided at low points near each end. Inspection and service covers shall be provided with gaskets. Hardware shall be corrosion-resistant. Motors shall conform to the requirements of NEMA MG 1. Motor heaters shall be energized when mainline contactor is de-energized, and water heaters shall be de-energized when mainline contactor is de-energized. Motors 15 kW (20 hp) and larger shall be provided with a suitable heater to prevent condensation during long periods of inactivity. One thermal sensitive device embedded in hoist motor windings shall be provided. Device and associated circuitry shall serve as an alarm activating an amber signal or pilot light visible to control stations when motor temperatures become excessive. Set point shall be set below the Class B insulation temperature limit. Thermal-sensitive device and associated circuits shall be self-restoring (automatic reset). Two-speed, two-winding motors with a solid-state control will not be allowed for creep-speed use.

2.4.4.2 Main Hoist Motor

Hoist motor shall be two-speed; two-winding NEMA design D squirrel cage ac type.

2.4.4.3 Bridge and Trolley Drive Motors

Bridge and trolley drive motors shall be two-speed; two-winding NEMA design B squirrel cage ac type rated.

2.4.4.4 Motor Enclosures

Motor enclosures shall be totally enclosed, non-ventilated (TENV).

2.4.4.5 Hoist Motor Insulation and Time Rating

Hoist motors shall be provided with insulation which has a Class F/60 minute minimum motor time rating based on an 80 degree C motor temperature rise above 40 degrees C ambient, with frame size selection based on continuous ratings.

2.4.4.6 Bridge and Trolley Motor Insulation and Time Rating

Bridge and trolley drive motors shall be provided with an insulation which has a Class F/60 minute minimum motor time rating based on 85 degrees C motor temperature rise above 40 degree C ambient with frame size selection based on continuous rating.

2.4.4.7 Micro-Motors

Micro-motors for main hoist bridge and trolley drives shall be industrial type, single-speed; single-winding; ac squirrel cage motor operation and shall conform to the requirements of NEMA MG 1. Micro-motor shall be totally enclosed, fan cooled (TEFC), with Class F or H insulation. Motor voltage rating shall comply with system supply voltage rating specified.

2.4.5 Electric Brakes

2.4.5.1 NOT USED

2.4.5.2 Hoist Brake Time Delay

One of the hoist holding brakes shall be provided with a time-delay setting (from 1 to 3 seconds). The time-delay shall be initiated upon releasing the control pushbutton or returning the master switch to OFF. Operation of mainline POWER-OFF pushbutton or power failure shall result in each hoist brake's setting without any time-delay.

2.4.5.3 Automatic Stop System

Electrically-controlled brakes shall be fail-safe spring set when power is interrupted. Brakes shall be released with a mainline contactor POWER-OFF pushbutton or a master switch for the associated drive. Brakes shall automatically stop when there is a power failure. Electric shall be designed to be mechanically released. Enclosures for electrical-controlled brake components shall be NEMA ICS 6 Type [_____]. Direct current shunt magnetic shoe brakes shall be provided with an electrical forcing circuit for rapid release of brake. Each shunt coil brake shall be circuited for both conductors to open simultaneously when the brake is de-energized.

2.4.6 Control System

A separate controller shall be provided for each motor; a quadraplex type for 4-motor bridge drives on ac central cranes. When 4-motor bridge drives are furnished and dc magnetic control is required, dc series-parallel connected motors shall be provided. Overload protection shall be in conformance with requirements of NEMA ICS 2 NFPA 70. When contactors are used for starting, stopping and reversing, contactors shall be mechanically and electrically interlocked.

2.4.6.1 Control Panels

Control panels shall be fabricated of solid sheet steel designed and constructed to conform to requirements of NEMA ICS 6 Type [_____]. Thermostatically-controlled heaters to keep control enclosure temperatures at or above 0 degrees C shall be provided in each static crane control panel. Control panel heaters shall be energized when mainline contactor is de-energized, and shall be de-energized when mainline contactor is energized to prevent anti-condensation. Control panel doors shall be hinged, equipped with gaskets and fitted with key-lock handle design, complete with a single key to open all locks.

2.4.6.2 Main Hoist Control

a. Hoist motor control system shall provide two speeds in each direction with of an electrically-operated, full-magnetic, across-the-line reversing type starter. Electrical and mechanical interlocks shall be used to prevent the operation of high speeds and low speeds.

2.4.6.3 Bridge and Trolley Control

a. Bridge and trolley main control systems shall provide two speeds in each direction with an electrically-operated, full-magnetic, across-the-line reversing type starter. Centrifugal switches shall be used in control circuit to prevent the plugging of trolley or bridge drive motors; each switch shall be arranged to set the associated drive's brake while attempts are made to plug. [The [bridge] [and] [trolley] main control system shall be provided with reduced voltage starting for all speed points.]

2.4.6.4 Drift Point

Trolley and bridge main control systems shall have a drift point between OFF and first speed control point in each direction or shall have a separate pushbutton.

2.4.6.5 Micro-Drive Motor and Clutch Control

Micro-drive system shall be designed such that when micro-drive is selected at control station, all main motors shall be disconnected, and all micro-drive clutches shall be energized. Operation of micro-drive motors shall be from crane control station. Micro-motor control systems shall provide single-speed in each direction by means of an electrically-operated, full-magnetic, full voltage type starter. Power shall not be applied to any micro-motor unless all clutches are fully engaged. If a clutch disengages during operation of micro-motors, the mainline contactors shall open and all brakes shall set. Application of power to any main motor shall be prevented with any clutch engaged. A transfer switch shall be provided at crane control station to allow transfer from either mode of operation to the other only when all brakes have been set for not less than 5 seconds. A single CLUTCH-ENGAGED green pilot light shall be provided when all clutches are energized; individual CLUTCH ENGAGED pilot lights shall be provided on drive control panels.

2.4.7 NOT USED

2.4.8 NOT USED

2.4.9 Radio Remote Control, Infrared Remote Control

2.4.9.1 General

Crane shall be equipped with a complete digital radio remote-control system to permit full control of crane from a portable wireless transmitter. System shall be the use-proven product of a manufacturer regularly engaged in design and manufacture of crane radio remote-control systems. System shall be of a "fail-safe" design so that the failure of any component or loss of signal will cause all crane motors to stop. The system shall permit complete, independent and simultaneous operation of all crane functions. System frequency shall be in the 72MHz-76MHz band. Receiver

shall include transfer relays if crane is also cab or pendant controlled.

2.4.9.2 Transmitter

Transmitter shall be portable and complete with an adjustable belt or harness. Crane motion switches shall be spring-return to OFF. Transmitter shall be provided with two spare batteries and battery charger to permit continuous operation. A key-lock with the key removable in the OFF position only shall be provided to control transmitter operation. A blue signal light mounted on crane visible from floor shall be provided to indicate the main contactor is energized. POWER-OFF toggle-switch shall be bright red. Transmitter shall be provided with the following controls:

Hoist-up/down.
Bridge-east/west.
Trolley-north/south.
POWER-ON.
POWER-OFF.

2.4.10 Protection

2.4.10.1 Main Line Disconnect

A main line disconnect consisting of a combination circuit breaker (50,000 AIC) and non-reversing starter, starter without overloads (mainline contactor) in NEMA Type 1 enclosure shall be provided. Mainline disconnect shall be controlled by a control circuit so that all crane motions will be stopped upon mainline undervoltage, overload, control circuit fuse failure, or operation of POWER OFF pushbutton. Mainline disconnect shall be equipped with energy isolating devices designed to accept lockout devices.

2.4.10.2 Isolation Transformer

The isolation transformer shall be an SCR drive type specifically designed for cranes, with a continuous rating which will exceed that required of the sum of rated full-load full-speed KVA of hoist plus 50 percent of rated full-load full-speed KVA of trolley and bridge motors plus the rated KVA of controls. Total KVA is then multiplied by 1.05 (efficiency factor). The isolation transformer shall be connected to load side of mainline disconnect of the transformer. Crane dc static control electric power distributed on the crane shall be supplied through this isolation transformer.

2.4.10.3 Surge Protection

Surge suppressors shall meet the requirements of UL 1449. Three metal oxide varistors shall be provided on the line side of each SCR drive isolation transformer to provide transient over-voltage protection.

2.4.10.4 Circuit Breakers

Circuit breakers shall meet the requirements of UL 489.

2.4.10.5 Overloads

Alternating current circuit overload relays shall be of the ambient compensated, automatic reset, inverse time type located in all phases individual motor circuits. Overload relays shall be arranged to de-energize the associated motor on an overload condition.

2.4.11 Limit-Switches

Geared limit-switches shall be heavy-duty quick-break double-pole double-throw type conforming to NEMA ICS 2. The geared limit-switch interruption of a motion in one direction shall not prevent the opposite motion. Geared limit-switches shall reset automatically. Limit-switch housings shall be NEMA Type 1. Limit-switches shall interrupt power to the primary and micro-drive control systems.

2.4.11.1 Hoist Upper Limit-Switches

Two limit-switches shall be provided for each hoist. A rotating-type adjustable geared-control circuit interrupt limit-switch shall provide hoist-up limiting. A secondary hoist-upper-limit shall be provided with a weight-operated power circuit limit-switch to prevent the hoist from raising beyond the safe limit. The secondary limit-switch shall operate to interrupt power to all hoist motor conductors, set the hoist holding brakes and directly open all "raise" power circuits.

2.4.11.2 Hoist Lower Limit-Switches

Hoists shall be provided with a rotating-type adjustable geared-control circuit interrupt limit-switch for hoist-down travel limiting. The hook downward vertical travel of the hook shall be field-adjustable to approximately 150 mm above working surface.

2.4.11.3 Bridge and Trolley Travel Limit-Switches

Runway (track-type) limit-switches shall be provided for crane bridge and trolley motions to stop the bridge and trolley motions, respectively. Limit-switch actuators shall be installed on building and trolley frame to actuate the limit-switches and stop the crane bridge or trolley prior to contacting the trolley frame bumpers. Trip mechanism for trolley motion shall be located on crane runway to trip the switch before the bumper contacts the stop. Trip mechanism for bridge motion shall be located on crane runway to trip switch before bumper contacts the stop. When the switch is tripped, the switch shall permit opposite travel in the direction of stop and then automatically reset.

2.4.12 Wiring

Wires shall be numbered or tagged at connection points. Splices shall be made in boxes or panels on terminals boards or standoff insulators. Motor loop, branch circuit and brake conductor selection shall be based on NFPA 70 for 90 degree C conductor rating on indoor cranes, and for 75 degree C conductor rating on outdoor cranes. Wire insulation shall be Type XHHW. Conductors in the vicinity of resistors and conductors connected to resistors shall be Type 5RML.

2.4.13 Electrification

2.4.13.1 Main Power Electrification

Main power electrification system shall provide power to crane starter/disconnect circuit breaker.

2.4.13.2 Crane Runway Conductors

Crane runway conductor system shall be the covered conductor bar system type designed and manufactured to meet UL requirements. Protective covers shall be the rigid or flexible self-closing type designed to cover all live conductors and shall be shaped to prevent accidental contact with conductors. Collectors shall be heavy-duty sliding shoe type compatible with the electrification system. Two tandem designed collector heads shall be provided for each conductor rail to provide redundancy.

2.4.13.3 Bridge Span Conductors

Bridge span conductor system shall be the rigid conductor/collector type.

2.4.14 Special Requirements

2.4.14.1 Warning Horn

A solid-state electronic warning horn shall be provided on the crane. Any bridge or trolley motion shall be accompanied by a continuous series of alternating tones. The warning horn shall not sound when the crane is in the micro-drive mode.

2.4.14.2 Accessory Power

Three-phase 208Y/120 volt ac power supplied via a circuit breaker and isolation transformer from the line side of the main line disconnect shall be used for accessory circuits on the crane. The circuit breaker shall have a NEMA Type 1 enclosure. The enclosure shall have provisions to lock the breaker in the OFF position. Each circuit breaker pole shall have individual thermal and magnetic trip elements, and the enclosure cover shall be complete with a button for mechanically tripping the circuit breaker. A three-phase 480 volt delta primary and 208Y/120 volt wye secondary general lighting transformer shall be supplied from the accessory circuit breaker and shall feed a 208Y/120 volt UL listed circuit breaker panelboard and a heater circuit breaker/combination starter. The panelboard shall supply branch circuits for utilization of various accessories such as receptacles, panel internal lighting, motor heaters and control enclosure which meets NEMA requirements. Transformer and panelboard shall have the same NEMA classification as the circuit breaker.

2.4.14.3 Receptacles

Receptacles shall be single-phase, 120-volt 15-amp, grounded, duplex types complete with metal weather-proof enclosure with self-closing weatherproof receptacle cover. A receptacle shall be provided on the trolley at each end of the front bridge walkway in the vicinity of bridge travel drive motors and in the cab. Several receptacles shall be provided in the vicinity of the control equipment equally spaced every 3 m. Breakers used to protect circuits supplying the receptacles for outside cranes shall incorporate ground fault current interruption feature and meet the requirements of UL 943.

2.4.14.4 NOT USED

2.4.14.5 NOT USED

2.4.14.6 NOT USED

2.4.14.7 Electrically-Driven Oil Pump Alarm

Electrically-driven lubricating pump shall be complete with an audible alarm and red light for indication of pump malfunction. Location of alarm shall be the factory standard location.

2.4.15 Load-Limit System

A load-limit visual/audible system shall be provided for the main hoist to inform the operator that the preset load has been exceeded. The load-limit system shall consist of a load-cell, load-sensing electronics, overload indicator lights, overload alarm bell and alarm cut-out switch. Load cell shall be mounted to receive the load from equalizing sheave pin or upper block sheave pin.

2.4.15.1 Load-Sensing Electronics

Load-sensing electronics shall be NEMA Type 1 enclosures. Alarm setpoint shall be adjustable.

2.4.15.2 Alarm and Indicator Light

An overload alarm light shall be provided to indicate a load greater than the preset maximum. Overload alarm shall be indicated with a red light and clearly labeled "OVERLOAD". A bell shall be provided to indicate when an overload condition exists. Provision shall be made to turn off the bell.

2.4.16 NOT USED

2.4.17 Fungus Resistance

Electrical connections such as terminal connections, circuit connections, components and circuit elements shall be coated with fungus-resistant varnish. Components and elements inherently inert to fungi or hermetically sealed shall not be treated. Elements whose operation will be adversely affected with the application of varnish shall not be treated.

2.5 ELECTROMAGNETIC INTERFERENCE SUPPRESSION

2.5.1 Shielded Cable

Pendant and festooned cables shall be the shielded type of braided tinned-copper. Each cable shielding shall be grounded with a single connection to equipment grounding conductor.

2.5.2 EMI/RFI Shielded Boxes

2.5.2.1 General

Boxes designed to house electronic and electrical control equipment, instruments, metering equipment, etc., in installations where electromagnetic compatibility and/or system security is required shall protect interior components from stray radio frequency (RF) fields and shall contain RF signals produced by interior components.

2.5.2.2 Construction

Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) shielded boxes shall be designed to meet UL 50 Type 12 and Type 13. The shielded boxes shall be constructed of 1.519 mm steel with seams continuously welded and ground smooth, without holes and knockouts. Cover

gasket shall be a combination of woven plated steel mesh and oil-resistant gasket which will provide an EMI/RFI seal as well as an oil-tight, dust-tight and water-tight seal between cover and body. Gasket shall be attached to cover with oil-resistant adhesive. Stainless steel cover clamps and screws which are quick and easy to operate shall be provided on three sides of hinged cover for positive clamping.

2.5.2.3 Attenuation

EMI/RFI shielded boxes shall be designed to provide maximum shielding of electric and magnetic components of radiated RF energy. RF filters shall be provided to suppress conducted radio frequency in cables and conductors. Shielded boxes shall provide attenuation greater than 60 db at 14.5 KHz to greater than 100 db at 1 MHz for magnetic fields and greater than 100 db from 14.5 KHz to 430 MHz for electric fields.

2.5.2.4 Finish

EMI/RFI shielded boxes shall be zinc-plated in accordance with ASTM B 633 SC3/Type II to provide corrosion-resistant conductive surfaces for gasket contact area and conduit entries. The finish coat shall match the crane finish.

PART 3 EXECUTION

3.1 ERECTION

The entire crane erection shall be performed in accordance with manufacturer's instructions under the full-time supervision of the manufacturer's representative. Contractor shall provide a written certificate from crane manufacturer indicating the crane is erected in accordance with manufacturer's recommendations before testing the completed installation.

3.1.1 Shop Assembly

Major crane components shall be shop assembled as completely as possible. Disassembled parts shall be match marked and electrical connections tagged after complete no-load shop testing. Parts and equipment at site shall be protected from weather, damage, abuse and loss of identification. Erection procedures shall ensure that the crane is erected without initial stresses, forced or improvised fits, misalignments, nicks of high-strength structural steel components, stress-raising welds and rough burrs. Damaged painted surfaces shall be cleaned and repainted after crane is erected.

3.1.2 Mechanical Alignment

Motors, couplings, brakes, gear boxes and drive components shall be aligned when reinstalled in accordance with manufacturer's instructions.

3.1.3 Electrical Alignment

Control system shall be aligned in accordance with manufacturer's instructions. A copy of the final alignment data shall be stored in control panel door and shall include but not be limited to timer settings, resistor tap settings, potentiometer settings, test-point voltages, supply voltages, motor voltages, motor currents and test conditions such as ambient temperature, motor load, date performed and person performing the alignment.

3.1.4 Welding

Welders, welding operations and welding procedures shall be qualified or prequalified in accordance with AWS D14.1. Welding shall be performed indoors and the surface of parts to be welded shall be free from rust, scale, paint, grease or other foreign matter. Minimum preheat and interpass temperatures shall conform to the requirements of AWS D14.1. Welding shall be performed in accordance with written procedures which specify the Contractor's standard dimensional tolerances for deviation from camber and sweep. Such tolerances shall not exceed those specified in accordance with AWS D14.1. Allowable stress ranges shall be in accordance with MHI CMAA 70. Welding of girders and beams shall conform with AWS D14.1.

3.1.5 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the facility, shall be as specified in Section 09900 PAINTING, GENERAL. Bridge crane including bridge, trolley, hoist and all attached items shall be painted in accordance with the manufacturer's standard practice. The complete crane shall be of one color. Bridge rail, supports and bracing shall be painted in accordance with Section 09900 PAINTING, GENERAL. Items such as surfaces in contact with the rail wheels, wheel tread, hooks, wire rope, surfaces on the electrical collector bars in contact with the collector shoes and nameplates shall not be painted.

3.2 ACCEPTANCE TESTING

3.2.1 General

Contractor shall provide all personnel necessary to conduct the required testing which shall include but not be limited to crane operators, riggers, rigging gear and test weights. Testing shall be performed in the presence of Contracting Officer or his designated representative. Contractor shall notify Contracting Officer 5 days prior to testing operations. Contractor shall operate all equipment and make all necessary corrections and adjustments prior to the testing operations witnessed by Contracting Officer. A representative of the Contractor responsible for procuring and installing hoist equipment shall be present to direct the field testing. Test loads shall be compact and permit a minimum of 50 percent of vertical lift. Test loads shall be minus 0 percent to plus 5 percent of the required weight, and shall be verified prior to testing. Test weights required are 4536 kg, 3630 kg and 363 kg. Operational testing shall not be performed until after building interior has been painted. Three copies of all test reports shall be furnished to Contracting Officer.

3.2.1.1 Test Sequence

Crane shall be tested in accordance with applicable paragraphs of this procedure in the sequence provided.

3.2.1.2 Test Data

Operating and startup current measurements shall be recorded for coils, hoist, trolley, and bridge motors using the appropriate instrumentation. Speed measurements shall be recorded as required by facility evaluation tests (normally at 100 percent load). Recorded values shall be compared with design specifications or manufacturer's recommended values and the abnormal differences shall be justified in the remarks or appropriate

adjustments performed. The high temperatures or abnormal operation of any equipment or machinery shall be noted, investigated and corrected. Hoist, trolley and bridge speeds shall be recorded during each test cycle.

3.2.1.3 Equipment Monitoring

Improper operation or poor condition of safety devices, electrical components, mechanical equipment and structural assemblies shall be monitored during the load test. Defects observed to be critical during the testing period shall be reported immediately to the Contracting Officer and the testing operations shall be suspended until the defects are corrected. During each load test and immediately following each load test, the following inspections shall be made:

a. Inspect for evidence of bending, warping, permanent deformation, cracking or malfunction of structural components.

b. Inspect for evidence of slippage in wire rope sockets and fittings.

c. Check for overheating in brake operation; check for proper stopping. All safety devices including emergency stop switches and POWER-OFF pushbuttons shall be tested and inspected separately to verify proper operation of the brakes. When provided, safety accessories including warning horn, lighting, gauges, warning lights and accuracy of wind indicating device and alarm shall be inspected.

d. Check for abnormal noise or vibration and overheating in machinery drive components.

e. Check wire rope sheaves and drum spooling for proper reeving and operation, freedom of movement, abnormal noise or vibration.

f. Check electrical drive components for proper operation, freedom from chatter, noise, overheating, and lockout/tagout devices for energy isolation.

g. Inspect gears for abnormal wear patterns, damage, or inadequate lubrication.

h. Verify that locations of crane capacity plates are visible from pendant operator's position.

3.2.1.4 Hooks

Hooks shall be measured for hook throat spread before and after load test. A throat dimension base measurement shall be established by installing two tram points and measuring the distance between the tram points to within 0.4 mm. This base dimension shall be recorded. Distance between tram points shall be measured before and after load test. An increase in throat opening by more than 1 percent from base measurement shall be cause for rejection.

3.2.2 No-Load Testing

3.2.2.1 Hoist Operating and Limit Switch Test

Load hook shall be raised and lowered through the full range of normal travel at rated speed and other crane speeds. Load hook shall be stopped

below the geared limit-switch upper setting. In slow speed only, proper operation of upper and lower limit-switches for primary and micro-drive motions shall be verified. The test shall be repeated a sufficient number of times (minimum of 3) to demonstrate proper operation. Brake action shall be tested in each direction. Proper time-delay shall be verified between the actuation of dual brakes.

3.2.2.2 Trolley Travel

Trolley shall be operated the full distance of bridge rails exercising all primary drive and micro-drive speed controls in each direction. Brake operation shall be verified in each direction. In slow speed or micro-drive, trolley bumpers shall contact trolley stops located on the bridge girders. In slow speed the proper operation (interrupt power, automatic reset) of the trolley limit-switches at both limits of trolley motion shall be tested.

3.2.2.3 Bridge Travel

Bridge shall be operated in each direction the full distance of runway exercising all primary drive and micro-drive speed controls. Brake operation shall be verified in each direction. In slow speed the proper operation (interrupt power, automatic reset) of the bridge limit-switches at both limits of bridge motion shall be tested. In slow speed or micro-drive the crane bridge bumpers shall contact the runway rail stops.

3.2.2.4 Hoist Loss of Power No-Load Test

Using the primary drive, hooks shall be raised to a height of approximately 3.5 m or less. While slowly lowering the hook the main power source shall be disconnected, verifying that the hook will not lower and that both brakes will set. Test shall be repeated using micro-drive controls.

3.2.2.5 Travel Loss of Power No-Load Test

With the hook raised to clear obstructions and trolley traveling in slow speed, the main power source shall be disconnected, verifying that the trolley will stop and the brake will set. Test shall be repeated for trolley using micro-drive speed. Test shall be repeated for bridge, micro-drive and slow speed primary drive controls.

3.2.3 Load Test

3.2.3.1 Hoist

Unless otherwise indicated, the following tests shall be performed using a test load of 125 percent (plus 5 percent, minus 0 percent) of rated load.

a. Hoist Static Load Test: Holding brakes and hoisting components shall be tested by raising the test load approximately 300 mm and manually releasing one of the holding brakes. Load shall be held for 10 minutes. First holding brake shall be reapplied and second holding brake released. Load shall be held for 10 minutes. Any lowering that may occur indicates a malfunction of brakes or lowering components.

b. Dynamic Load Test: Test load shall be raised and lowered through the full range operating in each speed. Machinery shall be completely stopped at least once in each direction to ensure proper

brake operation.

c. Hoist Loss of Power Test: After raising test load to approximately 2.5 m, slowly lowering the test load, the main power source and control pushbutton shall be released verifying that the test load will not lower and that both brakes will set. Test shall be repeated using micro-drive controls.

d. Trolley Dynamic Load Test: While operating the trolley the full distance of bridge rails in each direction with test load on the hook (one cycle), proper functioning of all primary drive and micro-drive speed control points and proper brake action shall be tested.

e. Bridge Dynamic Load Test: With test load on hook, bridge shall be operated for the full length of runway in both directions with trolley at each extreme end of bridge. Proper functioning of all primary drive and micro-drive speed control points and brake action shall be verified.

3.2.3.2 Trolley and Bridge Loss of Power Test

A test load of 100 to 105 percent of rated load shall be raised clear of any obstructions on operating floor. Starting at a safe distance from walls or other obstructions, a slow speed shall be selected using the trolley and bridge primary drive. While maintaining a safe distance to obstructions, the main power source shall be disconnected and brakes shall be verified to have set and that the equipment stops within the distance recommended by manufacturer.

3.2.4 Overload Tests

After the operational tests, bridge crane system and all functions of bridge crane shall be tested at 125 percent of rated load.

3.2.5 Acceleration and Deceleration Tests

The acceleration and deceleration of bridge and trolley shall be tested with approximately 10 percent of rated load at lowest possible location of hook. Bridge and trolley shall be operated to run up to high speed and then stopped without jarring or swinging the load.

3.2.6 Grounding Test

Hoist shall be tested to determine that the hoist, including hook and pendant, are grounded to building during all phases of hoist operation. The grounding of bridge and trolley shall be tested with approximately 10 percent of rated load on hook. Grounding shall be tested between hoist hook and the structure's grounding system.

3.2.7 Adjustments and Repairs

Adjustments and repairs shall be performed by Contractor under the direction of the Contracting Officer at no additional cost to the Government, until satisfactory conditions are maintained, and contract compliance is affected. After adjustments are made to assure correct functioning of the components, pertinent testing shall be repeated.

3.3 SCHEMATIC DIAGRAMS

Schematic diagrams for equipment shall be stored where indicated on drawings.

3.4 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

Contractor shall furnish a qualified experienced manufacturer's field service representative to supervise the crane installation, assist in the performance of the on site testing, and instruct personnel in the operational and maintenance features of the equipment.

3.5 FIELD TRAINING

Contractor shall conduct a training course for the operating staff. Training period shall consist of a total of 16 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. Course instructions shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, including all major elements of operation and maintenance manual. Course instructions shall demonstrate all routine maintenance operations such as lubrication, general inspection. Contracting Officer shall be given at least 2 weeks advance notice of field training.

3.6 ACCEPTANCE

Final acceptance of crane system will not be given until Contractor has successfully completed all testing operations, corrected all material and equipment defects, made all proper operation adjustments, and removed paint or overspray on wire rope, hook and electrical collector bars.

-- End of Section --

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Mechanical requirements that are applicable to all Division 15 sections in addition to Division 0 - CONTRACT REQUIREMENTS and Division 1 - GENERAL REQUIREMENTS.

B. Division 0 and Division 1 specifications shall take precedence where in conflict with Division 15.

C. Mechanical work covered by all sections within DIVISION 15 - MECHANICAL of these Specifications, including but not limited to:
1. Heating, ventilating, air conditioning and refrigeration systems and equipment.
2. Plumbing systems and equipment.
3. Fire protection systems and equipment.
4. Temperature control systems and equipment.

D. This section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Divisions 0 and 1:
1. Reference Standards, Codes and Fees
2. Quality Assurance
3. Submittals
4. Maintenance Manuals
5. Job Conditions
6. Accuracy of Data and Drawings
7. Electrical Requirements for Mechanical Equipment
8. Coordination Drawings
9. Record Documents
10. Identification
11. Fire-Stop Materials
12. Rough-ins

13. Field Tests
14. Excavation and Backfill
15. Adjusting and Cleaning
16. Installation
17. Painting

1.2 CONTRACTOR'S RESPONSIBILITY

A. The Contractor shall obtain and pay for all licenses and permits required to perform work covered by DIVISION 15 - MECHANICAL, and obtain and pay for all necessary inspections by all applicable authorities.

1.3 CODES AND STANDARDS

Select related codes or standards.

A. In addition to requirements of Divisions 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS, all work shall be manufactured, installed and labeled in accordance with the applicable provisions of the latest editions of the following codes and standards, including addenda and modifications made by local authorities.

1. Local Codes
2. State Codes
3. Federal Codes
4. ASME Boiler Code
5. AGA - American Gas Association
6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
7. AABC - Associated Air Balance Council
8. NEMA - National Electrical Manufacturer's Association
9. ANSI - American Society National Standards Institute
10. ASME - American Society of Mechanical Engineers
11. NFPA - National Fire Protection Association
12. NFPA - 101 Life Safety Code
13. ARI - Air-Conditioning and Refrigeration Institute
14. UL - Underwriters Laboratories, Inc.

15. Uniform Codes - Building, Mechanical, Plumbing, Fire Prevention, Etc.
16. ASPE - American Society of Plumbing Engineers.
17. OSHA - Occupational Safety and Health Act.
18. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc. 1985 HVAC Duct Construction Standards.

1.4 GOVERNMENT FURNISHED EQUIPMENT AND INSTALLATION

A. Refer to section 01000.

1.5 WORK SEQUENCE

A. Refer to section 01570.

1.6 QUALITY ASSURANCE

A. The use of manufacturer's names and catalog numbers in these specifications or on the drawings indicates the type, size, rating, capacity, design, quality, or kind of materials required and a closed specification is not intended, and similar and equal products of any reputable manufacturer which will satisfactorily perform the required functions will be acceptable, unless otherwise indicated by the words NO SUBSTITUTES, or unless otherwise specifically stated. The Contracting Officer reserves the right to reject all materials which he deems not equal to those specified, or which he decides will not satisfactorily perform the required functions.

B. Supply all equipment and accessories new and free from defects.

C. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

D. Supply all equipment and accessories in compliance with the applicable standards listed in this section and with all applicable national, state, and local codes.

E. When included, reflected ceiling plan drawings shall govern over mechanical and electrical drawings for location of ceiling-mounted elements.

F. In addition to all requirements specified hereinafter, each material and equipment item shall have all features as standard with its manufacturer and/or required for the complete operational system.

G. Capacities, ratings, sizes and other requirements not specified hereinafter shall be as scheduled or otherwise indicated on the drawings.

H. Hardware or software required to process date and time calculations shall be Year 2000 compliant and shall be capable to accurately process date/time data (including but not limited to calculating, comparing, and sequencing) from, into, and in between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if the other information technology exchanges data/time with it.

1.7 SUBMITTALS

A. Submittals shall be provided to the Contracting Officer as described in section 01300.

B. Submittals and shop drawings shall be submitted in accordance with Divisions 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS and in accordance with the following.

1. Carefully review the requirements of DIVISIONS 0 and 1.

2. All equipment, material and manufacturer's literature for each item contained within a specification section shall be submitted for approval at one time. Partial or multiple submittals will not be accepted. Each

submittal shall be bound in a tabulated high quality 3-ring binder. Disapproval of any submittal shall require complete resubmittal of the entire package.

3. The submittal shall include summary cover sheet(s) and manufacturer's literature under each tab of the submittal binder which together clearly indicate compliance or deviation from the specifications and drawings. Pages displaying multiple models from a single manufacturer shall be annotated to indicate intended model and all required accessories. Each submittal brochure shall be signed, on the index page, by Contractor. This signature shall indicate the Contractor has examined all data therein and found same to be in order.

4. Submission material and all shop drawings shall be marked up with the appropriate equipment tags relating the equipment to the drawings. Mark and reference each item on the submittal summary sheet and the manufacturer's literature to the appropriate paragraph number in the specifications. Blank manufacturer's standard catalogs will not be accepted.

5. Failure to comply with the above for a complete and clear submittal will result in resubmittal.

6. A minimum of (7) copies of all submittals shall be provided of which (3) will be returned to the Owner by the Contractor, (2) will be retained by the Contracting Officer, and (2) will be available for Contractor's use.

C. Maintenance Manuals:

1. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information

for each equipment item. Behind a separate tab for each piece of equipment, provide the following:

a. A copy of the equipment submittals and shop drawings as provided in (A) above.
b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions, as applicable.
d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
e. Servicing instructions and lubrication charts and schedules.

2. Before requesting acceptance of work, furnish the number of printed and bound sets required in DIVISIONS 0 and 1.

3. Detailed and simplified one line, color coded flow and wiring diagrams.

4. Schedule of valve identification.

5. Provide seven copies of all manuals.

D. Field test report: required by Section 15990 - BALANCING AND TESTING BY INDEPENDENT AGENCY. Provide seven copies.

1.8 JOB CONDITIONS

A. Examine related work and surfaces before starting work of any section.

B. Continuity of Services and Connections to Existing Work:

1. At no additional cost to the Contracting Officer, provide all necessary temporary connections and temporary facilities to accomplish the required continuity of services and existing operations.

2. Arrange all work to interfere as little as possible with the normal existing operations. Do not interrupt any existing utility or other service or existing operation at any time without Contracting Officer's prior approval. After each interruption has been made, make all necessary connections and alterations and restore services and avoid interferences with normal existing operations as quickly as possible.

3. Install new work and connect to existing work with minimum interference to existing facilities and maintain water and air tightness when applicable.

4. Temporary shutdowns of existing services:

   a. At no additional charges.
   b. At times not to interfere with normal operation of existing facilities.
   c. Only with written consent of Contracting Officer.

5. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.

6. Connect new work to existing work in neat and satisfactory high quality workmanship manner.

7. Restore existing disturbed work to original or better conditions.

1.9 ACCURACY OF DATA AND DRAWINGS

Modular Design System

A. These specifications shall not be construed to indicate that each individual trade be considered stand alone. Drawings and specifications constituting DIVISION 15 shall be considered components of a unified set of construction documents. Work required of other trades to support DIVISION 15 shall be provided under this contract to provide a complete and functional system. Examine the complete construction package for requirements from interfacing trades.

B. Building and structure dimensions: TAKE THESE FROM ARCHITECTURAL AND STRUCTURAL DRAWINGS.

1.10 ELECTRICAL CHARACTERISTICS, MOTOR SIZES, MOTOR STARTERS, CONTROLS, AND WIRING

A. DIVISIONS 0 and 1 - CONTRACT REQUIREMENTS and GENERAL REQUIREMENTS: These shall apply to the work related in this section.

B. Motor starters and other electrical control devices: Generally, motor starters for equipment motors shall be furnished by DIVISION 16 - ELECTRICAL; however, this section shall furnish ONLY those motor starters which may be specified hereinafter in this Section. Also, this section shall furnish all other electrical control devices required for the Mechanical system, unless otherwise specified.

C. Installation of electrical devices, EXCEPT those factory mounted on equipment: electrical control devices which require electrical connections ONLY, shall be installed by DIVISION 16 - ELECTRICAL. All control devices which are not factory mounted on the equipment and require piping, linkage, remote bulb, or other mechanical connections as well as electrical connections shall be installed by the Section that furnished the equipment involved, ready for electrical connection.

1. Electric wiring: Division 15 shall perform any and all control and interlock wiring necessary for the operation sequence described

in Section 15951 or on mechanical plans with properly licensed personnel. Any wiring requirements for control devices furnished under Division 15 shall be provided by Division 15. Wiring for control devices not furnished by Division 15 or devices that are factory mounted on mechanical equipment requiring electrical connections only shall be by Division 16. Division 16 shall provide dedicated 120 VAC, 15-20 amp power to designated control panel locations. Exact locations shall be coordinated between Division 15 and 16.

2. All necessary interlocking contacts and remote starting contacts and remote starting devices not installed on local control panels shall be supplied with the starters and it shall be the responsibility of Division 15 to coordinate the number of contacts required. If individual control transformers are required, provide the transformers necessary for the additional power required by auxiliary control devices. This coordination shall occur prior to ordering starters and the cost shall be included in the bid proposal.

3. Control wiring materials and installation shall conform to Division 16 requirements.

1.11 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 1 Section "PROJECT COORDINATION," to a minimum scale of 1:50 or larger if required in Division 1; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of piping, ductwork, equipment, and materials in all mechanical equipment rooms. Include the following:

   a. Clearances for installing and maintaining insulation.
   b. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   c. Equipment connections and support details.
   d. Exterior wall and foundation penetrations.
   e. Fire-rated wall and floor penetrations.
   f. Sizes and location of required concrete pads and bases.

2. Indicate the proposed locations of piping, ductwork, electrical equipment and materials along main duct routes and where crossing corridors.

3. Project drawings for mechanical and plumbing systems shall be made available to the contractor in Microstation format for use in coordination drawings.]

1.12 PROJECT RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT RECORD DOCUMENTS." In addition to the requirements specified in Division 1, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.

2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.) Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

5. Contract Modifications, actual equipment and materials installed.

6. These documents shall be prepared in Microstation format and provided with project closeout documentation in disk and hard copy format.

PART 2 - PRODUCTS

2.1 HOUSEKEEPING PADS

A. Provide 150 mm concrete pads for all floor mounted mechanical equipment such as circulating pumps, chillers, air handling units, etc. Pad dimensions shall be approximately 150 mm larger than the equipment in the width and depth dimensions. Bevel the edges of the pad to reduce chipping. Anchor pads to floor slabs with 200 mm, #16 dowels, 600 mm on center. Drill and epoxy grout dowels to floor prior to casting pad. Attach equipment to pad with minimum 20 mm expansion bolts. Refer to section 03300 for concrete specifications.

2.2 EQUIPMENT ACCESS

Modular Design System

A. Provide structural steel access platforms and/or catwalks for full and unfettered equipment access for periodic maintenance. Platforms shall be adequately supported and braced from facility structural components. Coordinate equipment access with handrails, ladders, braces etc. so as not block component removal and replacement. Provide all elevated access platforms with ladders and handrails in accordance with OSHA requirements. Refer to Section 05500 Metal Fabrications for construction specifications.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 FIELD TESTS

A. All piping shall be free of leaks, and test gauges shall show no loss of pressure for at least 30 minutes, after source of test pressure has been cut off, or as noted. Pipes may be tested in sections as the work progresses. Repair and retest all sections failing to pass tests, as required to obtain approval of tests. No caulking, welding or brazing will be permitted on threaded pipe or fittings to stop leaks. Replace with new material all cracked or otherwise defective pipe and fittings of all types, as approved. Furnish suitable testing equipment, give the Contracting Officer and all applicable authorities ample advance notice of all proposed tests and readiness of work for inspections, and conduct each test in their presence, as approved. Do not conceal or insulate piping and do not conceal ductwork until all inspections have been made and all required tests have been approved by the Contracting Officer

and all applicable authorities. Submit results for review.

B. Provide required labor, material, equipment and connections.

C. Test all piping, EXCEPT as otherwise specified below, as follows: hydrostatic test, at 150 percent of normal operating pressure of piping involved, or 690 kpa, whichever is higher, AFTER removing all air from piping involved in test.

1. Natural gas and fuel oil piping: 345 kpa test using air or inert gas.

2. Soil, waste, vent roof drainage, and acid waste piping: standard water test, by filling piping with water up to top of vent stack or highest point of piping test section involved, but no section tested with less than a 3 meter head with no pressure loss for at least 30 minutes.

3. Compressed air: air test at 150 percent of normal working pressure of piping involved, or 690 kpa, whichever is higher.

4. Fire protection piping: 1380 kpa two hour duration hydrostatic test, AFTER removing all air from piping involved in test, with pressure gauged at bottoms of standpipes. Conduct this test in presence of authorized representative of the Fire Department having jurisdiction.

5. Chilled water and heating water piping: Water test at 150% of normal working pressure of piping involved, or 690 kpa, whichever is higher.

6. Test all equipment in accordance with sections specified hereinafter.

D. Test all ductwork constructed to 500 pa W.G. class or higher, in accordance with leakage test method

recommended in 1985 SMACNA "Duct Construction Standards". After remedying audible leaks, total leakage on system shall not exceed one percent of system total design air flow rate.

3.3 EXCAVATION AND BACKFILL

A. Excavation, Underground Pipework:

1. Cut trenches to indicated and/or required lines, and to depths which will:

a. Provide full length bearing of pipe barrels on firm ground.
b. Provide 610 mm MINIMUM earth cover over all pipes outside of buildings and structures.

2. Piping shall be laid on a 152 mm bed of sand and backfilled with 305 mm of sand in 152 mm layers.

3. Seat pipe on sand fill as required to facilitate jointing, and to prevent pipe hubs, couplings and valves from bearing on sand before backfilling.

4. Sheet and brace excavations as required to prevent cave-ins and protect personnel and adjacent structures.

5. Where pipelines are below footings, horizontal distance between footings and pipelines shall be as required to provide not steeper than a 1:1 slope from footing bottoms to trench bottoms at all points.

B. Backfill, Trenches

1. After each pipeline has been laid, tested and approved, thoroughly hand tamp backfill into bell holes, around pipe, and up to 152 mm above pipe top.

2. Place remaining backfill in 203 mm maximum thickness loose layers, and with pneumatic or other suitable power tampers compact each layer to the backfill density specified in Division 2.

3. Backfill materials shall be of the following types:

   a. Up to 152 mm above pipe tops: sand, ONLY.
   b. From 152 mm above pipe tops up to finished grade or subgrade, as required.
      (1) Any materials removed from the excavation and suitable for backfill, except do not use as backfill material any pieces of the following material which are larger than 150 mm in their greatest dimensions: rock, stone, concrete, asphalt paving, or masonry.
      (2) Dispose of excavated materials which are not replaced as backfill, as approved.

C. Excavation and Backfill for Structures Related to Mechanical Work

1. This shall conform to applicable requirements in Division 2.

D. Unsuitable Subsurface Conditions

1. Where excavation bottoms at required elevations are found to be unstable, or where rock, cinders, rubbish, or other deleterious materials are encountered, extend excavations down to firm earth, but at least 152 mm below deleterious materials.

2. Bring excavation bottoms back up to required pipe laying subgrade by backfilling with suitable material, thoroughly compacted in place as specified above.

3. "Suitable material" shall be as specified above.

4. Dispose of excavated unsuitable subgrade materials, as approved.

E. Warning Tape for Buried Pipeline: Install detectable warning tape directly over every pipeline by burying tape as close to the surface as possible, but no less than 152 mm beneath finished grade.

3.4 ADJUSTING AND CLEANING

A. Flush or blow all welding slag, pipe joint compound, loose scale, and other debris from pipework before connecting equipment thereto.

B. After systems have been tested and before any field painting is commenced, clean up all work thoroughly. Remove all foreign matter which has accumulated in ducts, casings, enclosures, fixtures, and equipment. Clean and polish all valves, plates, and other surfaces that are not to be painted, so that they present a new and acceptable appearance.

C. Put systems in operation, test all fixtures and other equipment, remedy all leaks and defects, make all necessary adjustments, and remove all air from water circulating systems. Adjust all air and water flows to indicated and/or required quantities, and adjust all controls and other items as required to balance system and provide uniform air flows and uniform temperatures in air conditioned areas. Demonstrate that all controls and mechanical equipment function satisfactorily, as specified, as indicated, and as approved.

D. Sterilization of Domestic Water System: AFTER all water connections have been made to all fixtures and equipment, and BEFORE plumbing system is used by Owner, sterilize entire potable water system as specified below, and submit a written report certifying that this has been done in accordance

with the requirements of the State Department of Public Health.

1. Drain entire water system.

2. Refill entire water system with a sterilizing solution of potable water containing at least 50 parts per million of available chlorine.

3. Allow sterilizing solution to remain in water system for at least 24 hours, then drain all sterilizing solution from water system.

4. With potable water, flush all traces of sterilizing solution from entire water system through each fixture and each water outlet.

E. Strainers and Dirt Pockets: Clean out each of these; REMOVE EACH STRAINER SCREEN FOR CLEANING. Initially install very fine mesh screen for system cleaning and operate System to a minimum of 24 hours. Remove screen, clean it and replace it in system until a clean system is verified. Remove screen and replace with screen at mesh for normal operation.

F. Circulating Water Systems: Completely drain each of these, and refill with clean water.

G. Compressed air piping shall be cleaned in accordance with the requirements of Section 15481 - COMPRESSED AIR SYSTEM.

H. After systems have been tested and before putting any part of or the entire system in operation for Owner's beneficial use, insure that all necessary adjustments have been made.

1. Bearings and other items requiring lubrication, except factory permanently lubricated type: lubricate each of these as recommended by its manufacturer; this includes lubricated type plug valves.

2. Belts: adjust each of these to proper tension.

3. Filters: replace each disposable ("throw away") filter with a new clean filter. Clean each cleanable filter. NOTE: ALL FILTERS SHALL BE IN PLACE DURING TESTING AND ADJUSTING AND SHALL BE CLEAN.

4. Motor load tests: make an ammeter check of actual running current of each motor in mechanical system under operating conditions. Correct all motors which are found to be overloaded, as approved.

3.5 INSTALLATION

A. General: Sequence, coordinate and integrate the various elements of mechanical systems, materials, and equipment.

B. Equipment rooms and other areas in which equipment is to be installed have limiting dimensions. Coordinate mechanical systems, equipment, and materials installation with other building components. Install all mechanical work within these areas substantially as indicated, with ample unobstructed access space around each piece of equipment to facilitate proper installation, operation, and maintenance of equipment, and to allow ample space for plumbing, electrical, and other equipment indicated to be installed therein. Minor revisions in layout may be made subject to Architect's approval, but major changes in layout to accommodate proposed equipment which differs substantially from specified equipment in size and arrangement will not be considered. Each bidder shall determine before bidding that equipment upon which he proposes to base his bid will conform to these requirements. Install each equipment item in accordance with its manufacturer's recommendations, and as indicated on the drawings, and/or specified. If the drawings and/or specifications conflict with the manufacturer's recommendations, report this to

the Contracting Officer for his decision before proceeding with the work involved.

C. Equipment NOT furnished by mechanical section but requiring mechanical connections from other Sections and others furnishing this equipment, determine exact mechanical connection requirements; therefore, locations and arrangements of connections indicated for this equipment are APPROXIMATE ONLY.

D. Arrange for chases, slots and openings in other building components during progress of construction, to allow for mechanical installations.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

F. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.

G. Where installation heights are not detailed or dimensioned, and equipment requires periodic service, verify height with Owner and/or Architect prior to installation, otherwise install to provide the maximum headroom possible.

H. Coordinate connection of mechanical systems with exterior utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.

I. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

J. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

K. Generally, install pipework and ductwork as follows unless otherwise indicated.

1. Finished areas: conceal pipework and ductwork within pipe chases, above suspended ceiling and within other building construction, in offices, rest rooms, and other finished areas, unless otherwise indicated.

2. Unfinished areas: install above ground pipework and ductwork exposed in areas where pipe chases or suspended ceilings are not indicated or concealing is otherwise impracticable, in mechanical and electrical equipment rooms or storage areas, and other unfinished areas.

3. ALL areas: install pipework and ductwork parallel or at right angles with beams, walls, ceilings, and other building lines, in straight lines between required direction changes, with vertical runs plumb. Install exposed pipework and ductwork as close as practicable to walls, columns, ceilings, and overhead construction, and to provide maximum headroom and minimum interference with usable building space.

3.6 PAINTING

A. All surfaces shall be left clean and free from oil.

B. All equipment shall be factory prime coated and painted; however, the following may be shop prime coated and made ready for painting:

1. Tanks.
2. Structural supports and frames.

C. Where galvanizing is broken during fabrication or installation, recoat exposed areas with cold galvanizing compound.

D. Uncoated Hangers, Supports, Rods, and inserts shall be prime coated.

E. Exposed, uninsulated black steel piping, pipe supports, and pipe braces shall be prime coated.

F. All ductwork, conduit, insulation, pipe, and structures visible through grilles and diffusers shall be painted flat black.

G. Marred surfaces of prime coated or factory painted surfaces shall be painted and/or primed to match adjacent coat.

H. Provide enamel paint where specified.

I. Refer to Section 09900 for Painting.

3.7 IDENTIFICATION OF VALVING AND EQUIPMENT

A. Identify valves, (including main pipe sectionalizing valves and branch valves) except those on or within hand reach of equipment controlled thereby with a minimum 38 mm diameter round brass or aluminum tag stamped with 6 mm (minimum) height letters designating material controlled by valve, and attached to valve body with 1.3 mm solid copper or galvanized steel wire. Submit a typed valve identification schedule with the operating instructions and parts list submittal described above under article SUBMITTALS.

B. Equipment: Label each major mechanical equipment item (such as AHU, pump, fan, condensing unit, boiler, water heaters, etc.) with nameplate engraved with equipment designation and number, and securely attached to equipment.

C. Refer to Section 15190 for Mechanical Identification.

3.8 IDENTIFICATION OF PIPING

A. Identify piping with self-sticking vinyl cloth pipe markers and pipe marker arrows, each sized as recommended by marker manufacturer for outside diameter of pipe (including pipe insulation) labeled therewith. Marker background colors shall conform to OSHA, NFPA and ANSI pipe identification standards as scheduled in Table (I). Each pipe marker shall be lettered to indicate the material contained in the pipeline involved and arrows shall indicate direction of material flow in the pipelines.

B. Provide a full color piping Identification Schedule indicating material type within pipe and its corresponding color coding.

C. Locate Identification As Follows:

1. Mechanical Equipment Rooms:

a. Within 0.46m of each valve or valve assembly.
b. Within 0.92m of each 90 deg elbow, connection to equipment or vessel, point where pipe enters shafts and pierces outside walls.
c. On not over 6.1 m intervals along all exposed piping.

2. Above Suspended Ceilings:

a. Within 0.46 m of each valve or valve assembly.
b. At tees within 0.92 m of both main and branch.
c. Within 0.92 m of each 90 deg. elbow.

3. Piping Concealed in Chases or Shafts:

a. Each pipe visible through an access door or panel.

4. Piping Exposed in Rooms Other than Mechanical Equipment Areas:

   a. Omit identification of piping, 13 mm and smaller, exposed at connections to equipment or plumbing fixtures.

   b. With the above exception, identify at not less than (1) point each piping run visible in each room with identification on not over 6.1 m intervals.

D. Refer to Section 15190 for Mechanical Identification.

TABLE I
SCHEDULE OF PIPING IDENTIFICATION

CLASSIFICATION (Per ANSI A13.1)	BACKGROUND COLOR	LETTERING
Chilled Water Supply from Chiller	Green	White
Chilled Water Return to Chiller	Green	White
Domestic Cold Water	Green	White
Domestic Hotwater Supply	Green	White
Domestic Hotwater Return	Green	White
Equipment Drains	Green	White
Sanitary Drains	Green	White
Fire Protection Water	Red	White
Hot Water Supply From Boiler	Yellow	Black
Hot Water Return to Boiler	Yellow	Black
Plumbing Vent Lines	Green	White
Natural Gas	Yellow	Black
Compressed Air	Blue	White

3.9 FIRE-STOP MATERIALS

A. Seal around all pipes, ducts, tubing, cable, and conduit penetrating fire-rated partitions. Sealing system shall be UL listed system approved for installation in the partition to be penetrated. Follow all manufacturer instructions for installation to accomplish the required fire resistance rating. Refer to Section 07270 -

Modular Design System

Firestopping for additional fire-stopping requirements.

END OF SECTION 15010

SECTION 15121

PIPING EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints and compensators.

C. Pipe loops, offsets, and swing joints.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASTM A 36/A 36M - Specification for Structural Steel.

B. ASTM A 53 - Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless.

C. ASTM A 183 - Carbon Steel, Track Bolts and Nuts.

D. ASTM A 780 - Repair of Damaged Hot-Dipped Galvanized Coatings.

E. ASTM F 844 - Washers, Steel, Plain (Flat), Unhardened for General Use.

F. ASME B18.10 - Track Bolts and Nuts.

G. ASME B31.9 - Building Services Piping.

H. ASME Boiler & Pressure Vessel Code Section II "Material Specifications" And Section IX "Welding and Brazing Qualifications".

I. AWS D1.1 - Structural Welding code - Steel.

J. EJMA Standards.

K. SSPC - PA - Paint Application Specification No. 1, Shop, Field, and Maintenance Painting.

1.3 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations:
1. Installation Temperature: 10 degrees C.
2. Hot Water Heating: 99 degrees C.
3. Domestic Hot Water: 60 degrees C.
4. Safety Factory: 30 percent.

1.4 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Product Data:

1. Flexible Pipe Connectors: Provide schedule which shows manufacturer's figure number, size, location and indicates maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Provide schedule which shows manufacturer's figure number, size, location, and indicates maximum temperature and pressure rating, and maximum expansion compensation.

C. Welders Certificates: Contractor shall sign welders certificates, certifying that welders comply with requirements specified under Qualifications.

D. Design Data: Indicate selection calculations.

E. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include adjustment instructions for each type pipe expansion joint specified.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Design expansion compensating system under direct supervision of a Professional Engineer experienced in design of this work and licensed in jurisdiction where project is located.

C. Qualify welding processes and welding operators according to AWSDI.1 "Structural Welding Code - Steel".
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Provide five year warranty under provisions of Section 15010.

B. Warranty: Include coverage for leak free performance of packed expansion joints.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Steel Piping:

1. Acceptable Manufacturers:
   a. Mason Industries, Inc.
   b. Senior Flexonics, Inc.
   c. Proco Products, Inc.
   d. Hyspan Precision Products, Inc.
   e. Twin City Hose, Inc.
   f. Metraflex Company

2. Inner Hose: Stainless Steel.

3. Exterior Sleeve: Double braided stainless steel.

4. Pressure Rating: 1380 kPa WOG and 121 degrees C.

5. Joint: As specified for pipe joints.

6. Size: Use pipe sized units.

7. Maximum offset: 25 mm on each side of installed center line.

B. Copper Piping:

1. Acceptable Manufacturers:

a. Mason Industries, Inc.
b. Senior Flexonics, Inc.
c. Proco Products, Inc.
d. Hyspan Precision Products, Inc.
e. Twin City Hose, Inc.
f. Metraflex Company

2. Inner Hose: Bronze

3. Exterior Sleeve: Braided bronze.

4. Pressure Rating: 1380 kPa WOG and 121 degrees C.

5. Joint: As specified for pipe joints.

6. Size: Use pipe sized units.

7. Maximum offset: 25 mm on each side of installed center line.

2.2 EXPANSION JOINTS

A. Stainless Steel Bellows Type:

1. Acceptable Manufacturers:

a. Mason Industries, Inc.
b. Senior Flexonics, Inc.
c. Proco Products, Inc.
d. Hyspan Precision Products, Inc.
e. Twin City Hose, Inc.
f. Metraflex Company

2. Pressure Rating: 1380 kPa WOG and 121 degrees C.

3. Maximum Compression: 45 mm.

4. Maximum Extension: 6 mm.

5. Joint: As specified for pipe joints.

6. Size: Use pipe sized units

7. Application: Steel piping 76 mm and under.

B. External Ring Controlled Stainless Steel Bellows Type:

1. Acceptable Manufacturers:

a. Mason Industries, Inc.
b. Senior Flexonics, Inc.
c. Proco Products, Inc.
d. Hyspan Precision Products, Inc.
e. Twin City Hose, Inc.
f. Metraflex Company

2. Pressure Rating: 1380 kPa WOG and 121 degrees C.

3. Maximum Compression: 24 mm.

4. Maximum Extension: 8 mm.

5. Maximum Offset: 8 mm.

6. Joint: Flanged

7. Size: Use pipe sized units

8. Accessories: Internal flow liner.

9. Application: Steel piping over 76 mm.

C. Double Sphere, Flexible Compensator:

1. Acceptable Manufacturers:

a. Mason Industries, Inc.
b. Proco Products, Inc.
c. Hyspan Precision Products, Inc.
d. Twin City Hose, Inc.

e. Metraflex Company

2. Body: Neoprene and nylon.

3. Working Pressure: 1380 kPa.

4. Maximum Temperature: 121 degrees C.

5. Maximum Compression: 19 mm.

6. Maximum Elongation: 13 mm.

7. Maximum Offset: 13 mm.

8. Maximum Angular Movement: 30 degrees.

9. Joint: Galvanized flanges.

10. Size: Use pipe sized units.

11. Accessories: Control cables.
12. Application: Steel piping 51 mm and over.

D. Two-Ply Bronze Bellows Type:

1. Acceptable Manufacturers:

a. Mason Industries, Inc.
b. Senior Flexonics, Inc.
c. Proco Products, Inc.
d. Hyspan Precision Products, Inc.
e. Twin City Hose, Inc.
f. Metraflex Company

2. Construction: Bronze with anti-torque device, limit stops, internal guides.

3. Pressure Rating: 1380 kPa WOG and 121 degrees C.

4. Maximum Compression: 45 mm.

5. Maximum Extension: 6 mm.

6. Joint: As specified for pipe joints.

7. Size: Use pipe sized units.
8. Application: Copper piping.

2.3 ACCESSORIES

A. Pipe Alignment Guides:

1. Acceptable Manufacturers:

a. Grinnell Corp.
b. B-Line Systems, Inc.
c. Michigan Hanger Co.

2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 25 mm thick insulation, minimum 76 mm travel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Work shall be installed as shown and in accordance with manufacturer's instructions, diagrams and recommendations.

B. Construct spool pieces to exact size of flexible connection for future insertion.

C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Install pipe anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9, and to

prevent transfer of loading and stresses to connected equipment.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, or expansion joints where required.

G. Install pipe anchors according to expansion unit manufacturer's written instructions to control movement to compensators.

H. Where not otherwise indicated, install pipe anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Preset anchors as required to accommodate both expansion and contraction of piping.

I. Provide expansion loops as indicated on drawings.

J. Pipe alignment guides shall be installed as recommended by joint manufacturer, but in any case shall not be more than 1.52 m from an expansion joint except for lines 100 mm or smaller, where guides shall not be more than 0.61 m from the joint.

3.2 PAINTING

A. Touching up:

1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting".

2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with

manufacturer's recommendations and connectors are performing satisfactorily.

B. Prepare report covering installation of pipe expansion joints, pipe alignment guides, and pipe anchors. Include seal and signature of Registered Engineer licensed in jurisdiction where project is located, certifying compliance with specifications.

END OF SECTION 15121

SECTION 15140

SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASME B31.1 - Power Piping.

B. ASME B31.2 - Fuel Gas Piping.

C. ASME B31.5 - Refrigeration Piping.

D. ASME B31.9 - Building Services Piping.

E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

I. NFPA 13 - Installation of Sprinkler Systems.

J. NFPA 14 - Installation of Standpipe and Hose Systems.

K. UL 203 - Pipe Hanger Equipment for Fire Protection Service.

L. ASME B18.10 - Track Bolts & Nuts.

M. ASME Boiler & Pressure Vessel Code Section II "Material Specifications", Parts A, B & C, and Section IX "Welding & Brazing Qualifications".

N. ASTM A 36/A 36M - Specification for Structural Steel.

O. ASTM A 183 - Specification for Carbon Steel Track Bolts & Nuts.

P. ASTM A 780 - Practice for Repair of Damaged Hot-Dipped Galvanized Coatings.

Q. ASTM C33 - Specification for Concrete Aggregates.

R. ASTM C 150 - Specification for Portland Cement.

S. ASTM C 1107 - Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

T. ASTM F 844 - Specification for Washers, Steel Plain (Flat), Unhardened for General Use.

U. AWS D1.1 - Structural Welding Code - Steel.

V. MSS SP-90 - Guidelines on Terminology for Pipe Hangers & Supports.

W. NFPA 70 - National Electrical Code.

X. SSPC-PA 1 - Paint Application Specification No. 1, Shop, Field, & Maintenance Painting.

1.3 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers. Submit shop drawings for each type of hanger and support, indicating

dimensions, weights, required clearance, and methods of component assembly.

C. Product Data: Provide manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

F. Welder's Certificates: Contractor shall sign welders certificates, certifying that welders comply with requirements specified under Qualifications.

G. Pipe Hanger Schedule: Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.

1.4 REGULATORY REQUIREMENTS

A. Conform to International Mechanical code for support of plumbing and hydronic piping.

B. Supports for Sprinkler Piping: In conformance with NFPA 13.

1.5 QUALIFICATIONS

A. Qualify welding processes and welding operators according to AWSD1.1 "Structural Welding Code-Steel".

1. Certify that each welder has satisfactorily passed AWS Qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

Modular Design System

C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
   1. Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.

E. Use operators that are licensed by power-operated tool manufacturers to operate their tools and fasteners.

F. Licensed Engineer: Prepare hanger and support design drawings, and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Engineer, Licensed in Jurisdiction where project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Acceptable Manufacturers:

   1. Grinnell Corp.
   2. B-Line Systems, Inc.
   3. Michigan Hanger Co.

B. Fire Protection Piping:

   1. Conform to NFPA 13.

   2. Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.

   3. Hangers for Pipe Sizes 51 mm and Over: Carbon steel, adjustable, clevis.

   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 76 mm: Cast iron hook.

6. Wall Support for Pipe Sizes 102 mm and Over: Welded steel bracket and wrought steel clamp.

7. Vertical Support: Steel riser clamp.

8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Piping-plumbing DWV, plumbing water, compressed air, natural gas, hydronic and refrigerant.

1. Conform to MSS SP69.

2. Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 51 mm and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 76 mm: Cast iron hook.

6. Wall Support for Pipe Sizes 102 mm and Over: Welded steel bracket and wrought steel clamp.

7. Vertical Support: Steel riser clamp.

8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

A. Acceptable Manufacturers:

1. Grinnell Corp.
2. B-Line Systems, Inc.
3. Michigan Hanger Co.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 0.6 mm thick galvanized steel.

B. Metal Counterflashing: 0.9 mm thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 24.5 kg/sq m sheet lead.
2. Soundproofing: 5 kg/sq m sheet lead.

D. Flexible Flashing: 1.2 mm thick sheet butyl; compatible with roofing.

E. Caps: Steel, 0.9 mm minimum; 1.6 mm at fire resistant elements.

2.5 EQUIPMENT CURBS

A. Acceptable Manufacturers shall be same as that of equipment to be supported.

Modular Design System

B. Fabrication: Welded 1.3 mm galvanized steel shell and base, mitered 76 mm cant, variable step to match roof pitch (if required), 38 mm thick insulation, factory installed wood nailer. Curbs for installation on standing seam metal roof shall be specifically manufactured for standing seam installation.

2.6 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 1.3 mm thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 1.3 mm thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 07270.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

F. Firestopping Insulation: Glass fiber type, non-combustible.

G. Sealant: Acrylic; refer to Section 07900.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Specific hanger and support requirements are specified in the section specifying the equipment and systems.

C. Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3.2 INSERTS AND ATTACHMENTS

A. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms. Install reinforcing bars through openings at top of inserts.

B. Provide inserts for placement in concrete formwork. Install concrete inserts in new construction prior to placing concrete.

C. Install powder actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 102 mm thick.

D. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 102 mm thick.

3.3 PIPE HANGERS AND SUPPORTS

A. Comply with MSS SP-69 and SP-89 for hanger selections, applications and maximum spacing. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Support horizontal piping as scheduled.

C. Install hangers to provide minimum 13 mm space between finished covering and adjacent work.

D. Place hangers within 305 mm of each horizontal elbow.

E. Use hangers with 38 mm minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with 1.5 m maximum spacing between hangers.

G. Support vertical piping every 4 meters along riser. Support vertical cast iron pipe at each hub.

H. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers. Field fabricated heavy-duty steel trapezes shall be from ASTM A36 steel shapes selected for loads being supported. Weld steel according to AWSD-1.1.

I. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

J. Support riser piping independently of connected horizontal piping.

K. Provide copper plated hangers and supports for copper piping.

L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units, without disengagement of supported pipe.

M. Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in pipe shafts, and suspended ceiling spaces are not considered exposed.

N. Support fire protection systems piping independent of other piping.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.

P. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including any spacers, to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation to match adjoining pipe insulation.

3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads. Refer to Section 15010.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

D. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

E. Provide rigid anchors for pipes after vibration isolation components are installed.

F. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.5 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Seal floor and mop sink drains watertight to adjacent materials.

C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

D. Provide curbs for mechanical roof installations 350 mm minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

E. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 25 mm above finished floor level, and caulk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.7 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections to that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.8 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.9 PAINTING

A. Touching Up

1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting".

2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.10 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

3.11 HANGER SCHEDULE

PIPE SIZE (mm)	MAX. HANGER SPACING (m)	HANGER ROD DIAMETER (mm)
18 to 32	2.0	10
38 to 51	3.0	10
64 to 76	3.0	13
102 to 152	3.0	16
C.I. Bell and Spigot(or No-Hub) and at Joints	1.5	16

END OF SECTION 15140

SECTION 15170

MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single phase electric motors.

B. Three phase electric motors.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

D. NEMA MG 1 - Motors and Generators.

E. NFPA 70 - National Electrical Code.

F. UL 1004 - Electric Motors.

1.3 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 3.7 KW.

D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Operation Data: Include instructions for safe operating procedures.

C. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of electric motors for commercial use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

B. Motors and components shall comply with NFPA 70 "National Electrical Code", and shall be NRTL Listed as defined in "National Electrical Code," Article 100. Comply with MENA MG1, "Motors and Generators".

C. Motors and components shall comply with UL 1004, "Motors, Electric."

1.6 REGULATORY REQUIREMENTS

A. Conform to NFPA 70.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.8 WARRANTY

A. Provide five year warranty under provisions of Section 15010.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Baldor Electric Co.

B. Eaton Corp.

C. General Electric Co.

D. MagneTek Inc.

E. A. O. Smith Co.

F. Westinghouse Motor Co.

G. Emerson Electric Co.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.

B. Electrical Service:

1. Refer to Section 16180 for required electrical characteristics.

C. Type

1. Open drip-proof except where specifically noted otherwise.
2. Motors: Design for continuous operation in 40 degrees C environment.

3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Motors with frame sizes 254T and larger: Energy Efficient Type.

D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

F. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.3 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C) temperature rise insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C) temperature rise insulation, minimum 1.15 Service Factor, prelubricated ball bearings.

2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C) temperature rise insulation, minimum 1.15 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C) temperature rise insulation, NEMA Service Factor, prelubricated ball bearings.

G. Enclosed Motors: Class A (50 degrees C) temperature rise insulation, minimum 1.15 Service Factor, prelubricated ball bearings.

2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 16481.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: To NEMA MG 1.

K. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

L. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

M. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 - EXECUTION

3.1 APPLICATION

A. Motors located in air cooled condensers. Totally enclosed type.

3.2 INSTALLATION

A. Install in accordance with manufacturer's published instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

D. Mount direct connected motors securely in accurate alignment.

E. Mount belt drive motors using adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer's recommendations.

COMMISSIONING

F. Check operating motors, both factory and field-installed, for unusual conditions during normal operation. Coordinate with the commissioning of the equipment for which the motor is a part.

G. Report any unusual conditions, and correct deficiencies of field-installed units.

3.3 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

KW	3600 RPM	1800 RPM	1200 RPM	900 RPM
0.12-0.25	1.35	1.35	1.35	1.35
0.37	1.25	1.25	1.25	1.15
0.56	1.25	1.25	1.15	1.15
0.75	1.25	1.15	1.15	1.15
1.12-111.85	1.15	1.15	1.15	1.15

3.4 PERFORMANCE SCHEDULE: THREE PHASE - ENERGY EFFICIENT, OPEN DRIP-PROOF

KW	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
0.75	1200	145T	81	72
1.12	1200	182T	83	73
1.50	1200	184T	85	75
2.24	1200	213T	86	60
3.73	1200	215T	87	65
5.60	1200	254T	89	73
7.46	1200	256T	89	74
11.19	1200	284T	90	77
14.91	1200	286T	90	78
18.64	1200	324T	91	74
22.37	1200	326T	91	78
29.83	1200	364T	93	77
37.29	1200	365T	93	79
44.74	1200	404T	93	82
55.93	1200	405T	93	80
74.57	1200	444T	93	80
93.21	1200	444T	93	84

Modular Design System

0.75	1800	143T	82	84
1.12	1800	145T	84	85
1.50	1800	145T	84	85
2.24	1800	182T	86	86
3.73	1800	184T	87	87
5.60	1800	213T	88	86
7.46	1800	215T	89	85
11.19	1800	256T	91	85
14.91	1800	256T	91	86
18.64	1800	284T	91	85
22.37	1800	286T	92	88
29.83	1800	324T	92	83
37.29	1800	326T	93	85
44.74	1800	364T	93	88
55.93	1800	365T	93	88
74.57	1800	404T	93	83
93.21	1800	405T	93	86
111.85	1800	444T	93	85
149.14	1800	445T	94	85
1.12	3600	143T	82	85
1.50	3600	145T	82	87
2.24	3600	145T	84	85
3.73	3600	182T	85	86
5.60	3600	184T	86	88
7.46	3600	213T	87	86
11.19	3600	215T	89	89
14.91	3600	254T	90	89
18.64	3600	256T	90	92
22.37	3600	284T	91	91
29.83	3600	286T	92	92
37.29	3600	324T	93	89
44.74	3600	326T	93	91
55.93	3600	364T	93	88
74.57	3600	365T	92	88

3.5 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED

KW	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
0.75	1200	145T	81	72
1.12	1200	182T	83	65
1.50	1200	184T	85	68
2.24	1200	213T	85	63
3.73	1200	215T	86	66
5.60	1200	254T	89	68
7.46	1200	256T	89	75
11.19	1200	284T	90	72
14.91	1200	286T	90	76
18.64	1200	324T	90	71
22.37	1200	326T	91	79
29.83	1200	364T	92	78
37.29	1200	365T	92	81
44.74	1200	404T	92	83
55.93	1200	405T	92	80
74.57	1200	444T	93	83
93.21	1200	445T	93	85
0.75	1800	143T	82	84
1.1	1800	145T	84	85
1.5	1800	145T	84	85
2.24	1800	182T	87	83
3.73	1800	184T	88	83
5.60	1800	213T	89	85
7.46	1800	215T	90	84
11.19	1800	254T	91	86
14.91	1800	256T	91	85
18.64	1800	284T	92	84
22.37	1800	286T	93	86
29.83	1800	324T	93	83

37.29	1800	326T	93	85
44.74	1800	364T	93	87
55.93	1800	365T	93	87
74.57	1800	405T	94	86
93.21	1800	444T	94	87
111.85	1800	445T	94	88
149.14	1800	447T	95	87
1.12	3600	143T	82	85
1.50	3600	145T	82	87
2.24	3600	182T	82	87
3.73	3600	184T	85	88
5.60	3600	213T	86	86
7.46	3600	215T	86	86
11.19	3600	254T	88	91
14.91	3600	256T	89	89
18.64	3600	284T	90	92
22.37	3600	286T	91	92
29.83	3600	324T	91	91
37.29	3600	326T	90	92
44.74	3600	364T	91	93
55.93	3600	365T	91	91
74.57	3600	405T	92	92

END OF SECTION 15170

SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASME/ANSI A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Submit list of wording, symbols, letter size, letter style and color coding required for each identification material and device.

C. Valve Schedule: Submit valve schedules for each piping system. Reproduce on Standard size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification. Mark valves intended for emergency shutoff and similar special uses. Furnish extra copies (in addition to mounted copies) for Maintenance Manuals as specified in Division 1 Section "PROJECT CLOSEOUT".

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of tagged valves.

1.5 QUALIFICATIONS

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identifying devices.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices after completion of covering and painting where devices are applied to surfaces. Install identifying devices prior to painting where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Acceptable Manufacturers:

1. Seton Co.
2. Brady USA, Inc.
3. Almetek Industries, Inc.

B. Description: Laminated three-layer plastic with engraved white letters on dark contrasting background color.

2.2 TAGS

A. Acceptable Manufacturers:

1. Seton Co.
2. Brady USA, Inc.
3. Almetek Industries, Inc.

B. Metal Tags: Brass 6 mm (minimum) stamped letters; tag size minimum 38 mm diameter with smooth edges.

Modular Design System

C. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 PIPE MARKERS

A. Acceptable Manufacturers:
1. Seton Co.
2. Brady USA, Inc.
3. Almetek Industries, Inc.

B. Color: Conform to ASME/ANSI A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 152 mm wide by 0.10 mm thick, manufactured for direct burial service.

2.4 CEILING TACKS

A. Acceptable Manufacturers:

1. Seton Co.
2. Brady USA, Inc.
3. Almetek Industries, Inc.

B. Description: Steel with 19 mm diameter color coded head.

C. Color code as follows:
1. Yellow - HVAC equipment
2. Red - Fire dampers/smoke dampers
3. Green - Plumbing valves
4. Blue - Heating/cooling valves

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers completely around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 152 to 203 mm below finished grade, directly above buried pipe.

F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify thermostats relating to terminal boxes or valves with nameplates.

I. Identify valves in main and branch piping with tags.

J. Identify air terminal units and radiator valves with numbered tags.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 19 mm diameter and smaller. Identify service, flow direction, and

pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6.1 m on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

M. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

N. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 LABELING AND IDENTIFYING

A. Plastic markers with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.

1. Fasten markers on pipes smaller than 152 mm by one of following methods:

a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
b. Adhesive lap joint in pipe marker overlap.
c. Laminated or bonded application of pipe marker to pipe (or insulation).
d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 19 mm wide, lapped 38 mm minimum at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands as follows wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, plenums) and exterior non-concealed locations.

1. Near each valve and control device.

2. Near each branch connection, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.

3. Near penetrations through walls, floors, ceilings, or enter non-accessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Space at a maximum of 15.2 m intervals along each run. Reduce intervals to 7.6 m in congested areas of piping and equipment.

7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. Valve Tags: Install valve tag on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shut-off valves, faucets, convenience and lawn-watering hose bibbs, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.

1. Install mounted valve schedule in each major equipment room.

D. Equipment Signs: Install engraved plastic laminate signs or equipment markers on or near each major item of mechanical equipment.

1. Provide signs for following general categories of equipment:

a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Meters, gages, thermometers, and similar units.

c. Fuel-burning units including boilers, furnaces, and heaters.
d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
e. Heat exchangers, coils, evaporators and similar equipment.
f. Fans, blowers, primary balancing dampers, and mixing boxes.
g. Packaged HVAC central-station and zone-type units.
h. Tanks and pressure vessels.
i. Strainers, filters, humidifiers, water treatment systems, and similar equipment.

2. Lettering Size: Minimum 6 mm for name of unit where viewing distance is less than 0.6 m, 13 mm for distances up to 1.8 m, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

3. Terms on Signs: In addition to name of identified unit distinguish between multiple units, indicate operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Plasticized Tags: Install within concealed space to reduce amount of text in exposed sign (outside concealment), where equipment to be identified is concealed above acoustical ceiling or similar concealment.

1. Identify operational valves and similar minor equipment items located in unoccupied spaces (including machine rooms) by installing plasticized tags.

F. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers and arrows showing duct system service and direction of flow.

1. Location: In each space where ducts are exposed or concealed by removable ceiling system. Locate

signs near points where ducts enter into concealed space and at maximum intervals of 15.2 m.

3.4 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices which have become visually blocked by work of this Division or other Divisions.

B. Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 15190

SECTION 15245

VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fiberglass Pads and Shapes.

B. Neoprene Pads.

C. Vibration Isolation Springs.

D. Pad-Type Isolators.

E. Plate-Type Isolators.

F. Double-Plate-Type Isolators.

G. Threaded Double-Plate-Type Isolators.

H. All-Directional Anchors.

I. Neoprene Mountings.

J. Spring Isolators, Free-Standing.

K. Spring Isolators, Housed.

L. Spring Isolators, Vertically-Restrained.

M. Equipment Rails.

N. Fabricated Equipment Bases.

O. Inertia Base Frames.

P. Roof-Curb Isolators.

Q. Isolation Hangers.

R. Riser Isolators.

S. Spring Isolators, Earthquake-Restrained.

T. Thrust Restraints.

1.2 PERFORMANCE REQUIREMENTS

A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division-15 sections.

B. Provide vibration isolation on all motor driven equipment over 0.15 kW, plus connected piping and ductwork.

C. Provide minimum static deflection of isolators for equipment as indicated.

1. Floor Mounted, Under 15 kw
   a. Under 400 rpm: 50 mm
   b. 400 - 600 rpm: 25 mm
   c. 600 - 800 rpm: 13 mm
   d. 800 - 900 rpm: 5 mm
   e. 1100 - 1500 rpm: 4 mm
   f. Over 1500 rpm: 3 mm

2. Floor Mounted, Over 15 kw
   a. Under 400 rpm: 65 mm
   b. 400 - 600 rpm: 51 mm
   c. 600 - 800 rpm: 25 mm
   d. 800 - 900 rpm: 13 mm
   e. 1100 - 1500 rpm: 5 mm
   f. Over 1500 rpm: 4 mm

3. Suspended
   a. Under 800 rpm: 89 mm
   b. 800 - 900 rpm: 51 mm
   c. 1100 - 1500 rpm: 25 mm
   d. Over 1500 rpm: 13 mm

D. Use concrete inertia bases for fans having static pressure in excess of 0.87 kPA or motors in excess of 30 kW, and on base mounted pumps over 7.5 kW.

1.3 QUALIFICATIONS

Modular Design System

A. Manufacturers:

1. Firms regularly engaged in manufacture of vibration control products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

2. Except as otherwise indicated, obtain vibration control products from single manufacturer.

3. Engage manufacturer to provide technical supervision of installation of vibration control products.

1.4 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases, and show location of equipment anchoring points, coordinated with equipment manufacturer's shop drawings.

C. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

D. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

E. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

F. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements or Division 1.

1.5 PROJECT RECORD DOCUMENTS

Modular Design System

A. Submit under provisions of Section 15010.

B. Record actual locations of hangers including attachment points.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Mason Industries, Inc.

B. Peabody Noise Control, Inc.

C. Vibration Eliminator Co., Inc.

D. Vibration Mountings and Controls, Inc.

2.2 INERTIA BASES, FRAMES AND RAILS

A. Fabricated Equipment Bases:

1. Where supplementary bases are indicated for use with isolator units to support equipment (base not integral with equipment), provide welded rectangular unit, fabricated of structural steel shapes, plates and bars complying with ASTM A36, as shown. Provide welded support brackets at points indicated, and anchor base to spring isolator units. Except as otherwise indicated arrange brackets to result in lowest possible mounting height for equipment, but provide minimum of 25 mm. Provide bolt holes in base matching anchor bolt holes in equipment.

2. Where indicated, provide for auxiliary motor slide base under motor or motor slide rails for adjusting belt tension. Design primary base for bolting of rails or slide base in position.

3. Where sizes of base framing members are not indicated, fabricate base with depth of structure not less than 0.10 x longest span of base, rigidly braced to support equipment without deflections or

distortions which would be detrimental to equipment or equipment performance.

B. Inertia Base Frames:

1. Where inertia bases are indicated for use with isolation units to support equipment, provide rectangular structural beam channel, or complete sheet metal box concrete forms for floating foundations, with materials complying with ASTM A36. Frame unit as shown or, if not shown, with minimum depth of 0.08 x longest dimension of base, but not less than 153 mm deep. Size frame as shown or, if not shown, so that weight of frame plus concrete fill will be greater than operating weight of equipment supported. Provide steel reinforcing both ways with both ends of reinforcing butt welded to base framing.

2. Provide welded support brackets at points indicated, and anchor base frame to spring isolator units.

3. Provide anchor bolts, located as required for equipment anchorage and supported for casting of concrete.

2.3 SPRING TYPE ISOLATORS

A. Vibration Isolation Springs:

1. Wound-steel compression springs, of high-strength spring alloy steel; with spring diameter not less than 0.8 of compressed height of spring at rated loads. Provide minimum additional travel to solid, equal to 50% of rated deflection. Provide spring wire with elastic limit stress exceeding stress at solid deflection.

B. Spring Isolators, Free-Standing:

1. Except as otherwise indicated, provide vibration isolation spring between top and bottom loading plates, and with pad-type isolator bonded to bottom of bottom loading plate. Include studs or

cups to ensure centering of spring on plates. Include leveling bolt with lock nuts and washers, centered in top plate, arranged for leveling and anchoring supported equipment as indicated.

2. Include holes in bottom plate for bolting unit to substrate as indicated.

C. Spring Isolators, Housed:

1. Except as otherwise indicated, provide vibration isolation spring between telescoping steel housings with top and bottom loading plates, and with pad-type isolator bonded to bottom of loading plate. Include resilient inserts to separate and guide telescoping housings.

2. Equip top loading plate with equipment anchorages as indicated or as required for support and attachment.

3. Include pad-type isolator bonded to top of top loading plate, except on units with leveling bolts.

4. Include holes in bottom plate for bolting unit to substrate.

D. Isolation Hangers:

1. Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for 3 times rated loading of units. Fabricate units to accept misalignment of 15 deg. in any direction before contacting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.

2. Provide vibration isolation spring with cap in lower part of hanger and rubber hanger element in top, securely retained in unit.

3. Provide hangers, precompressed to rated load to limit deflection during installation. Design so hanger may be released after full load is applied.

E. Riser Isolators:

1. Suspend risers from, or support risers by, spring hangers or spring isolators. Wherever possible, anchor risers at central point with resilient anchors. Provide hanger or mounting deflection of 0.75" (19 mm) except in those expansion locations where additional deflection is required to limit deflection or load changes to ± 25% of initial deflection. Provide sliding guides held in position by resilient anchors, located between anchor points and end of piping, spaced as indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PERFORMANCE OF ISOLATORS

A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

3.3 APPLICATIONS

A. General:

1. Except as otherwise indicated, select vibration control products in accordance with the Latest Edition of the ASHRAE Handbook, HVAC Applications Volume, under the Chapter entitled "Sound and Vibration Control", Table 27.

B. Piping:

1. For piping connected to equipment mounted on vibration control products, install isolation hangers as indicated, and for first 3 points of support for pipe sizes 102 mm and less.

3.4 INSTALLATION

A. General:

1. Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration control materials and units. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

D. Install inertia base frames on isolator units as indicated, so that minimum of 25 mm clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.

E. Locate isolation hangers as near overhead support structure as possible.

F. Weld riser isolator units in place as required to prevent displacement from loading and operations.

G. Bases:

1. Set steel bases for 25 mm clearance between housekeeping pad and base.

2. Set concrete inertia bases for 51 mm clearance between housekeeping pad and base.

3. Adjust equipment level.

H. Install spring hangers without binding.

I. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

J. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

K. Provide pairs of horizontal limit springs on hanger supported, horizontally mounted axial fans.

L. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector as follows:

1. Up to 102 mm Diameter: First three points of support.
2. Select three hangers closest to vibration source for minimum 25 mm static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 25 mm static deflection or 1/2 static deflection of isolated equipment.

M. Connect wiring to isolated equipment with flexible hanging loop.

3.5 ADJUSTING AND CLEANING

A. Examine systems under provisions of Section 15010.

B. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated.

C. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possible short-circuit unit isolation.

3.6 PIPE ISOLATION SCHEDULE

Pipe Size Inch (mm)	Isolated Distance from Equipment
25	3.0 m
51	4.6 m
76	6.1 m
102	7.6 m

3.7 EQUIPMENT ISOLATION SCHEDULE

ISOLATED EQUIPMENT	I S O L A T O R T Y P E
HVAC Pumps	Concrete Inertia Base With Housed Spring Isolators
Gas Fired Air Units	Isolation Hangers
Unit Heaters	Isolation Hangers
Water Chillers	Housed Spring Isolators
Inline Fans	Isolation Hangers
Centrifigual Utility Sets	Equipment Base with Spring Isolators

Air Compressors Spring Isolators

END OF SECTION 15245

SECTION 15260

PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

C. ASTM C195 - Mineral Fiber Thermal Insulation Cement.

D. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

E. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

F. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

G. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

H. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

I. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

J. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

K. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

L. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

M. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

N. ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).

O. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

P. ASTM E84 - Surface Burning Characteristics of Building Materials.

Q. ASTM E96 - Water Vapor Transmission of Materials.

R. NFPA 255 - Surface Burning Characteristics of Building Materials.

S. UL 723 - Surface Burning Characteristics of Building Materials.

T. ASHRAE 90A - Energy Conservation in New Building Design.

U. ASTM A 167 - Specification for Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet & Strip.

V. ASTM C 553 - Specification for Mineral Fiber Blanket & Felt Insulation.

W. ASTM C 612 - Specification for Mineral Fiber Block & Board Thermal Insulation.

X. ASTM D 579 - Specification for Greige Woven Glass Fabrics.

Y. NFPA 90A - Air Conditioning & Ventilating Systems.

Z. NFPA 90B - Warm Air Heating & Air Conditioning Systems.

AA. NFPA 96 - Removal of Smoke & Grease-Laden Vapors from Commercial Cooking Equipment.

AB. NFPA 220 - Standard on Types of Building Construction.

1.3 SUBMITTALS:

A. Submit under provisions of Section 15010.

B. Product Data: Provide product description, list of materials, k-value, and thickness for each service, and locations.

C. Material Certificates: Submit material certificates, signed by the manufacturers, certifying that materials comply with specified requirements where laboratory test reports cannot be obtained.

D. Test Reports: Submit material test reports prepared by a qualified independent testing laboratory. Certify that insulation meets specified requirements.

E. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation facings, cements, and adhesives, when tested according to ASTM E84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

B. Materials: Unless otherwise specified, insulation not covered with a jacket shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to

be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material that shall be used in the actual construction. Jackets shall comply with the flame spread and smoke developed ratings of 25/50 as determined by ASTM E 84.

1.5 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 15010.

B. Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

1.8 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of piping systems.

PART 2 - PRODUCTS

2.1 GLASS FIBER

A. Acceptable Manufacturers:

1. Owens-Corning
2. Certainteed Corp.
3. Manville/Schuller
4. Knauf Fiber Glass

B. Insulation: Shall meet requirements of ASTM C547, and shall be rigid molded and noncombustible.

1. ksi value : ASTM C335, 0.035 at 24 degrees C.
2. Minimum Service Temperature: -28.9 degrees C.
3. Maximum Service Temperature: 150 degrees C.
4. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket

1. Jacket shall meet requirements of ASTM C921. White kraft paper shall be reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
3. Secure with self sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

D. Tie Wire: 1.2 mm stainless steel with twisted ends on maximum 305 mm centers.

E. Vapor Barrier Lap Adhesive

1. Acceptable Manufacturers:

a. Halstead Industries, Inc.
b. Hardcast, Inc.
c. Loctite Corp.

2. Adhesive shall be waterproof, fire-retardant type, and shall be compatible with insulation used.

F. Insulating Cement/Mastic

1. Cement/Mastic shall meet requirements of ASTM C195, with hydraulic setting on mineral wool.

G. Indoor Vapor Barrier Finish

1. Vinyl emulsion type acrylic shall be compatible with insulation used, and shall have white color.

H. Insulating Cement

1. Cement shall meet requirements of ASTM C449.

2.2 CELLULAR GLASS

A. Acceptable Manufacturers:

1. Pittsburgh Corning Corp.

B. Insulation shall meet requirements of ASTM C552.

1. 'ksi' value: 0.058 at 24 degrees C.
2. Maximum Water Vapor Transmission: 0.1 perm.

2.3 CELLULAR FOAM

A. Acceptable Manufacturers:
1. Armstrong World Industries, Inc.
2. Halstead Industrial Products
3. Rubatex Corp.

B. Insulation shall meet requirements of ASTM C534, and shall be flexible, cellular elastomeric, molded or sheet.

1. 'ksi' Value: ASTM C177 or C518; 0.04 at 24 degrees C.
2. Minimum Service Temperature: -40 degrees C.
3. Maximum Service Temperature: 104 degrees C.
4. Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
5. Moisture Vapor Transmission: ASTM E96; 0.20 perm inches.

6. Maximum Flame Spread: ASTM E84; 25.
7. Maximum Smoke Developed: ASTM E84; 50.
8. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive

1. Adhesive shall be air dried, contact type, and shall be compatible with insulation used.

2.4 JACKETS

A. PVC Plastic

1. Jacket shall meet requirements of ASTM C921, and shall have one piece molded type fitting covers and sheet material, with off white color.

a. Minimum Service Temperature: -40 degrees C.
b. Maximum Service Temperature: 66 degrees C.
c. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
d. Maximum Flame Spread: ASTM E84; 25.
e. Maximum Smoke Developed: ASTM E84; 50.
f. Thickness: 0.50 mm.
g. Connections: Pressure sensitive color matching vinyl tape.

2. Covering Adhesive Mastic

a. Mastic shall be compatible with insulation used.

B. Aluminum Jacket shall meet requirements of ASTM B209.

1. Thickness: 0.64 mm sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 51 mm laps.
4. Fittings: 0.4 mm thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 10 mm wide; 0.38 mm thick aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 PREPARATION

A. Surface Preparation:
   1. Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mixing:
   1. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless steel surfaces with demineralized water.
   2. Follow cement manufacturer's printed instructions for mixing and portions.

3.3 INSTALLATION

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical systems. Install materials in accordance with manufacturer's instructions.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation of jacket in either the wet or dry state.

C. Install vapor barriers on insulated equipment having surface operating temperatures below 16 deg C.

D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

E. Install insulation with smooth, straight, and even surfaces.

F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier. On exposed piping, locate insulation, and cover seams in least visible locations.

G. Finish and seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Seal Ends: Except for flexible elastomeric cellular foam insulation, taper ends at 0.79 Rad angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular foam insulation square and seal with adhesive.

I. Apply adhesives and coatings at the manufacturer's recommended coverage-per-gallon rate.

J. Keep insulation materials dry during application and finishing.

K. Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment.
   1. Flexible connectors.
   2. Vibration control devices.
   3. Fire protection piping systems.
   4. Sanitary drainage and vent piping.
   5. Below grade piping.
   6. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.
   7. Piping specialties including air chambers, unions, strainers, check valves, and flow regulators.

L. Tightly butt longitudinal seams and end joints. Bond with adhesive.

M. Stagger joints on double layers of insulation.

N. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.

O. Apply insulation with a minimum number of joints.

P. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Cover circumferential joints with butt strips, at least 76mm wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 102 mm on center.

3. Longitudinal Seams: Overlap seams at least 38 mm. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 102 mm on center.

4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.

6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 51 mm in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

Q. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 51 mm from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer. Refer to Division 7 Section "Joint Sealants."

R. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer. Refer to

Division 7 for firestopping and fire-resistant joint sealers.

S. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.

1. Use same material and thickness as adjacent pipe insulation.

2. Overlap nesting insulation by 51 mm or 1-pipe diameter, which ever is greater.

3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.

4. Insulate elbows and tees smaller than 76 mm pipe size with premolded insulation.

5. Insulate elbows and tees 76 mm and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.

T. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in Division 15 Section "Supports and Anchors." For cold surface piping, extend insulation on anchor legs a minimum of 305 mm and taper and seal insulation ends.

1. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.

U. Insulated cold pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory applied or field applied.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.

3. Finish with glass cloth and vapor barrier adhesive.

4. PVC fitting covers may be used.

5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

V. For insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.

3. Finish with glass cloth and adhesive.

4. PVC fitting covers may be used.

5. For hot piping conveying fluids 60 degrees C or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

6. For hot piping conveying fluids over 60 degrees C, insulate flanges and unions at equipment.

W. Inserts and Shields:

1. Application: Piping 51 mm diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert Location: Between support shield and piping and under the finish jacket.

4. Insert Configuration: Minimum 152 mm long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

3.4 GLASS FIBER PIPE INSULATION INSTALLATION

A. Bond insulation to pipe with lagging adhesive.

B. Seal exposed ends with lagging adhesive.

C. Seal seams and joints with vapor barrier compound.

3.5 CELLULAR GLASS PIPE INSULATION INSTALLATION

A. Cellular Glass Insulation:

1. Join sections of cellular glass insulation with vapor barrier compound. Secure insulation with manufacturer's recommended adhesive. Seal joints with manufacturer's recommended joint sealer.

2. Multiple Layer Installations: Stagger joints of multilayer installations. Secure inner layer with glass fiber reinforced tape. Secure outer layers with 2 metal bands for each insulation section.

3. Finishing: Apply manufacturer's recommended vapor barrier mastic.

3.6 CELLULAR FOAM INSULATION INSTALLATION

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.

B. Valves, Fittings, and Flanges:

1. Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.

2. Miter cut materials to cover soldered elbows and tees.

3. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.7 JACKETS

A. Foil and Paper Jackets (FP):

1. Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2-inch (38mm)laps at longitudinal joints and 3-inch (76mm)wide butt strips at end joints.

2. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

B. Interior Exposed Insulation: Install continuous aluminum jackets for all piping below 3 m above floor. All other exposed piping to receive continuous PVC jackets.

C. Exterior Exposed Insulation: Install continuous stainless-steel jackets and seal all joints and seams with waterproof sealant.

D. Install metal jacket with 51 mm overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 305 mm on center and at butt joints.

E. Install the PVC jacket with 25 mm overlap at longitudinal and butt joints and seal with adhesive.

F. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.8 FINISHES

A. Paint finished insulation as specified in Division 9 Section "Painting."

B. Flexible Elastomeric Cellular Foam Insulation:

1. After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.9 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.10 GLASS FIBER INSULATION SCHEDULE

PIPING SYSTEMS

A. Plumbing Systems

Domestic Hot Water Supply
Domestic Hot Water Recirc
Domestic Cold Water
Plumbing Vents Within
3 Meters of the Exterior

B. Heating Systems

Heating Hot Water Supply
Heating Hot Water Return

3.11 CELLULAR GLASS INSULATION SCHEDULE

PIPING SYSTEMS

A. Cooling Systems

Chilled Water Supply
Chilled Water Return

3.12 CELLULAR FOAM INSULATION SCHEDULE

PIPING SYSTEMS

A. Cooling Systems

Cold Condensate Drains
Condensate Drains from Cooling Coils
Refrigerant Suction where not factory insulated
Refrigerant Hot Gas where not factory insulated

3.13 ABOVE GROUND COLD PIPELINE INSULATION THICKNESS

Pipe Size, mm

Service or Range of Temp degrees C		Run-outs* (6→38) (660→838)	(6→32)	(38→76)	(89→125)	(152→254)	(305→610)
16 to 2	(CF)	½	1	1			
	(CG)	2	1-1/2	1-1/2	2	2	2
1 to -17	(CG)	3-1/2	2-1/2	2-1/2	2-1/2	3	3
-18 to -34	(CG)	4	3	3	3	3-1/2	3-1/2

NOTES: (CG) - Cellular Glass
(GF) - Glass Fiber

(CF) - Cellular Foam

* When runouts to terminal units exceed 3.7 m, the entire length of runout shall be insulated like the main feed pipe.

3.14 REQUIRED THICKNESS (IN INCHES) OF PIPE INSULATION FOR HANDLING FLUIDS OTHER THAN DOMESTIC HOT WATER TO 121 degrees C.

k = thermal conductivity (average) Btu/hr. sq. ft. degree/in. thickness at a mean temperature of 29 degrees C.

Thermal conductivity k	Pipe Size, mm 51 or >	64→76	102	127→152	63
0.25	1.5	1.5	2.0	2.0	2.0
0.30	1.5	2.0	2.5	2.5	2.5
0.35	2.0	2.5	2.5	2.5	3.5
0.40	2.5	3.5	3.5	3.0	4.0
0.45	3.0	4.0	4.0	3.5	4.5

3.15 REQUIRED THICKNESS (IN INCHES) OF PIPE INSULATION FOR PIPES HANDLING DOMESTIC HOT WATER. (GF) - GLASS FIBER

Range of Service degrees C	Runouts* 6→38	Pipe Size, mm 51 or >	63→76	102	127→152	203
61 to 200 (GF)	1.0	1.5	1.5	1.5	1.5	1.5

* When runouts to terminal units exceed 3.7 m, the entire length of runout shall be insulated like the main feed pipe.

END OF SECTION

SECTION 15280

EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment insulation.

B. Covering.

C. Breeching insulation.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

C. ASTM C195 - Mineral Fiber Thermal Insulation Cement.

D. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

E. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

F. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

G. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

H. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

I. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

J. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

K. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

L. ASTM C640 - Corkboard and Cork Pipe Thermal Insulation.

M. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

N. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

O. ASTM E84 - Surface Burning Characteristics of Building Materials.

P. ASTM E96 - Water Vapor Transmission of Materials.

Q. NFPA 255 - Surface Burning Characteristics of Building Materials.

R. UL 723 - Surface Burning Characteristics of Building Materials.

S. ASHRAE 90A - Energy Conservation in New Building Design.

T. ASTM A 167 - Specification for Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet & Strip.

U. ASTM C 547 - Specification for Mineral Fiber Preformed Pipe Insulation.

V. ASTM D 579 - Specification for Greige Woven Glass Fabrics.

W. NFPA 90A - Air Conditioning & Ventilating Systems.

X. NFPA 90B - Warm Air Heating & Air Conditioning Systems.

Y. NFPA 96 - Removal of Smoke & Grease-Laden Vapors from Commercial Cooking Equipment.

Z. NFPA 220 - Standard on Types of Building Construction.

1.3 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Product Data: Provide product description, list of materials, k-value, and thickness for equipment scheduled.

C. Material Certificates: Submit material certificates, signed by the manufacturer, certifying that materials comply with specified requirements where laboratory test reports cannot be obtained.

D. Test Reports: Submit test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

E. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation facings, cements, and adhesives, when tested according to ASTM E84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

B. Materials: Unless otherwise specified, insulation not covered with a jacket shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material that shall be used in the actual construction. Jackets shall comply with the

flame spread and smoke developed ratings of 25/50 as determined by ASTM E 84.

1.5 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

1.8 SEQUENCING AND SCHEDULING

A. Schedule insulation application testing of equipment.

PART 2 - PRODUCTS

2.1 GLASS FIBER, RIGID

A. Acceptable Manufacturers:

1. Owens-Corning

2. Certainteed Corp.
3. Manville/Schuller
4. Knauf Fiber Glass

B. Insulation shall meet requirements of ASTM C612, and shall be rigid and noncombustible.

1. 'ksi' value: ASTM C335, 0.035 at 24 degrees C.
2. Maximum service temperature: 232 degrees C.
3. Maximum moisture absorption: 0.1 percent by volume.
4. Density: 48 kg/cu m density.

C. Vapor Barrier Jacket

1. Jacket shall be Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.

2. Moisture vapor transmission: ASTM E96; 0.04 perm. inches.

3. Secure with self sealing longitudinal laps and butt strips.

4. Secure with outward clinch expanding staples and vapor barrier mastic.

D. Facing: 25 mm galvanized steel hexagonal wire mesh stitched on both faces of insulation.

E. Vapor Barrier Lap Adhesive

1. Adhesive shall be waterproof, fire-retardant type, and shall be compatible with insulation used.

F. Insulating Cement/Mastic

1. Cement/mastic shall meet requirements of ASTM C195 with hydraulic setting on mineral wool, and shall be compatible with insulation used.

2.2 CELLULAR FOAM

A. Acceptable Manufacturers:

Modular Design System

1. Armstrong World Industries, Inc.
2. Halstead Industrial Products
3. Rubatex Corp.

B. Insulation shall meet requirements of ASTM C534, and shall be flexible, cellular elastomeric, molded or sheet.

1. 'ksi' value: ASTM C177 or C518; 0.04 at 24 degrees C.
2. Minimum service temperature: -40 degrees C.
3. Maximum service temperature: 104 degrees C.
4. Maximum moisture absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
5. Moisture vapor transmission: ASTM E96; 0.20 perm inches.
6. Maximum flame spread: ASTM E84; 25.
7. Maximum smoke developed: ASTM E84; 50.
8. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive

1. Adhesive shall be air dried, contact type, and shall be compatible with insulation used.

2.3 JACKETS

A. Aluminum Jacket shall meet requirements of ASTM B209.

1. Thickness: 0.064 mm sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 51 mm laps.

4. Metal Jacket Bands: 0.38 mm thick aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 PREPARATION

A. Surface Preparation:
1. Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mixing:
1. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless steel surfaces with demineralized water.
2. Follow cement manufacturer's printed instructions for mixing and portions.

3.3 INSTALLATION

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical systems. Install materials in accordance with manufacturer's instructions.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated equipment having surface operating temperatures below 16 deg C.

D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

E. Install insulation with smooth, straight, and even surfaces.

F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier. On exposed equipment, locate insulation, and cover seams in least visible locations.

G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Seal Ends: Except for flexible elastomeric cellular foam insulation, taper ends at 45 degree (0.79 Rad) angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular foam insulation square and seal with adhesive.

I. Apply adhesives and coatings at the manufacturer's recommended coverage-per-gallon rate.

J. Keep insulation materials dry during application and finishing.

K. Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment.
   1. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
   2. Flexible connectors.
   3. Vibration control devices.
   4. Testing laboratory labels and stamps.
   5. Nameplates and data plates.
   6. Access panels and doors in air distribution systems.

L. Install board and block materials with a minimum dimension of 305 mm and a maximum dimension of 1219 mm.

M. Groove, score, and bevel insulation materials as required to fit as closely as possible to the equipment, and to fit contours of equipment. Stagger end joints. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

N. Insulation Thicknesses Greater than 51 mm: Install insulation in multiple layers with staggered joints.

O. Bevel insulation edges for cylindrical surfaces for tight joint.

P. Secure sections of insulation in place with wire or bands spaced at 229 mm centers, except for flexible elastomeric cellular foam insulation.

Q. Protect exposed corners with corner angles under wires and bands.

R. Manholes, Handholes and Information Plates: Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

S. Removable Insulation: Install insulation on components that require periodic inspecting, cleaning, and repairing for easy removal and replacement without damage to adjacent insulation.

T. Pumps: Where insulation is indicated, fabricate galvanized steel boxes lined with insulation. Fit boxes around pumps and coincide joints in box with the splits in the pump casings. Fabricate joints with outward bolted flanges.

U. Finishing: Except for flexible elastomeric cellular foam insulation, apply 2 coats of vapor barrier compound to a minimum thickness of 1.6 mm. Install a layer of glass cloth embedded between layers.

V. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

W. Insulated dual temperature equipment or cold equipment containing fluids below ambient temperature:

1. Provide vapor barrier jackets, factory applied or field applied.

2. Finish with glass cloth and vapor barrier adhesive.

3. Insulate entire system.

X. For insulated equipment containing fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.

2. Finish with glass cloth and adhesive.

3. For hot equipment containing fluids 60 degrees C or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

4. For hot equipment containing fluids over 60 degrees C, insulate flanges and unions with removable sections and jackets.

Y. Inserts and Shields:

1. Application: equipment 38 mm diameter or larger.
2. Shields: galvanized steel between hangers and inserts.

3. Insert location: between support shield and equipment and under the finish jacket.

4. Insert configuration: minimum 150 mm long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

Z. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

3.4 GLASS FIBER EQUIPMENT INSULATION INSTALLATION

A. Secure insulation with anchor pins and speed washers.

B. Space anchors at maximum intervals of 18 inches (457 mm)in both directions and not more than 3 inches (76 mm) from edges and joints.

C. Apply a smoothing coat of insulating and finishing cement to finished insulation.

3.5 CELLULAR FOAM INSULATION INSTALLATION

A. Install sheets of the largest manageable size.

B. Apply full coverage of adhesive to the surfaces of the equipment and to the insulation.

C. Butt insulation joints firmly together and apply adhesive to insulation edges at joints.

3.6 JACKETS

A. Foil and Paper Jackets (FP)

1. Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 38 mm laps at longitudinal joints and 76 mm wide butt strips at end joints.

2. Seal openings, punctures, and breaks in vapor barrier jackets, and exposed insulation with vapor barrier compound.

B. Interior Exposed Insulation: Install continuous glass cloth jackets.

1. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 51 mm overlap at joints. Embed glass cloth between (2) 1.6 mm thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

C. For equipment in mechanical equipment rooms or in finished spaces, finish with aluminum jacket.

3.7 FINISHES

A. Paint finished insulation as specified in Division 9 Section "Painting."

B. Flexible Elastomeric Cellular Foam Insulation:

1. After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.8 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.9 GLASS FIBER, RIGID INSULATION SCHEDULE

EQUIPMENT	THICKNESS mm
A. Plumbing Systems	
Domestic Hot Water Storage Tanks	51 mm
B. Heating Systems	
Pump Bodies	51 mm
Air Separators	51 mm
Expansion Tanks	51 mm
Flue Gas Breeching	152 mm

3.10 CELLULAR FOAM INSULATION SCHEDULE

EQUIPMENT	THICKNESS (mm)
A. Cooling Systems	
Pump Bodies	38 mm
Air Separators	38 mm
Expansion Tanks	38 mm
Chiller Cold Surfaces (Not Factory Insulated)	64 mm
Cold Thermal Storage Tanks	64 mm

END OF SECTION

SECTION 15290

DUCTWORK INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ductwork insulation.

B. Insulation jackets.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

E. ASTM E84 - Surface Burning Characteristics of Building Materials.

F. ASTM E96 - Water Vapor Transmission of Materials.

G. NFPA 255 - Surface Burning Characteristics of Building Materials.

H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

I. UL 723 - Surface Burning Characteristics of Building Materials.

J. ASHRAE 90A - Energy Conservation in New Building Design.

K. ASTM A 167 - Specification for Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet & Strip.

L. ASTM C 195 - Specification for Mineral Fiber Thermal Insulating Cement.

M. ASTM C 449 - Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating & Finishing Cement.

N. ASTM C 534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet & Tubular Form.

O. ASTM C 921 - Specification for Determining the Properties of Jacketing Materials for Thermal Insulation.

P. NFPA 90A - Air Conditioning & Ventilating Systems.

Q. NFPA 90B - Warm Air Heating & Air Conditioning Systems.

R. NFPA 96 - Removal of Smoke & Grease-Laden Vapors from Commercial Cooking Equipment.

S. NFPA 220 - Standard on Types of Building Construction.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: Provide product description, list of materials, k-value, and thickness for each service, and locations.

B. Material Certificates: Submit material certificates, signed by the manufacturer, certifying that materials comply with specified requirements where laboratory test reports cannot be obtained.

C. Test Reports: Submit material test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and

installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E84, by UL or other testing or inspecting organization acceptable to the authority, having jurisdiction. Label insulation with appropriate markings of testing laboratory.

B. Materials: Unless otherwise specified, insulation not covered with a jacket shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material that shall be used in the actual construction. Jackets shall comply with the flame spread and smoke developed ratings of 25/50 as determined by ASTM E 84.

1.5 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

1.8 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of duct systems.

PART 2 PRODUCTS

2.1 GLASS FIBER, FLEXIBLE

A. Acceptable Manufacturers:

1. Owens-Corning
2. Certainteed Corp.
3. Manville/Schuller
4. Knauf Fiber Glass

B. Insulation shall meet requirements of ASTM C553, and shall be flexible, noncombustible blanket type.

1. 'Ksi' value: ASTM C518, 0.31 at 0.045 at 24 degrees C.

2. Maximum service temperature: 121 degrees C.

3. Maximum moisture absorption: 0.20 percent by volume.

4. Density: 24.

C. Vapor Barrier Jacket

1. Jacket shall be Kraft paper reinforced with glass fiber

yarn and bonded to aluminized film.

2. Moisture vapor transmission: ASTM E96; 0.04 perm inches.

3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape

1. Tape shall be Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Tie Wire shall be Annealed steel, 1.6 mm.

2.2 GLASS FIBER, RIGID

A. Acceptable Manufacturers:

1. Owens-Corning
2. Certainteed Corp.
3. Manville/Schuller
4. Knauf Fiber Glass

B. Insulation shall meet requirements of ASTM C612, and shall be rigid, noncombustible blanket.

1. 'Ksi' value: ASTM C518, 0.29 0.042 at 24 degrees C.

2. Maximum service temperature: 121 degrees C.

3. Maximum moisture absorption: 0.20 percent by volume.

4. Density: 24 kg/cu m.

C. Vapor Barrier Jacket

1. Jacket shall be Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.

2. Moisture vapor transmission: ASTM E96; 0.04 perm inches.

3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape

1. Tape shall be Kraft paper reinforced with glass fiber yarn, and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.3 JACKETS

A. Aluminum Jacket shall meet requirements of ASTM B209.

1. Thickness: 0.064 mm sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 51 mm laps.

4. Fittings: 0.4 mm thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 10 mm wide; 0.38 mm thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 PREPARATION

A. Surface Preparation:

1. Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mixing:

1. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless steel surfaces with demineralized water.

2. Follow cement manufacturer's printed instructions for mixing and portions.

3.3 INSTALLATION

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system. Install materials in accordance with manufacturer's instructions.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated ducts and plenums having surface operating temperatures below 16 deg C.

D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

E. Install insulation with smooth, straight, and even surfaces.

F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Seal Ends: Taper ends at 45 degree (0.79 Rad) angle and seal with lagging adhesive.

I. Apply adhesives and coatings at the manufacturer's recommended coverage-per-gallon rate.

J. Keep insulation materials dry during application and finishing.

K. Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment.

1. Factory-insulated flexible ducts.

2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.

3. Flexible connectors.

4. Vibration control devices.

5. Testing laboratory labels and stamps.

6. Nameplates and data plates

7. Access panels and doors in air distribution systems.

L. Install block and board insulation as follows:

1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 305 mm apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.

2. Speed Washers Attachment: secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 457 mm apart each way and 76 mm from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.

M. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:

1. Smaller Than 610 mm: Bonding adhesive applied in 150 mm-

wide transverse strips on 305 mm centers.

2. 610 mm and Larger: Anchor pins spaced 305 mm apart each way. Apply bonding adhesive to prevent sagging of the insulation.

3. Overlap joints 76 mm.

4. Seal joints, breaks and punctures with vapor barrier compound.

N. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.

3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

O. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.

2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

3.4 JACKETS

A. Foil and Paper Jackets (FP):

1. Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 38 mm laps at longitudinal joints and 76 mm wide butt strips at end joints.

2. Seal openings, punctures, and breaks in vapor barrier jackets, and exposed insulation with vapor barrier compound.

B. For ductwork exposed in mechanical equipment rooms or in finished spaces below 3 meters above finished floor, finish with aluminum jacket.

3.5 FINISHES

A. Paint finished insulation as specified in Division 9 Section "Painting."

B. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.6 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.7 FLEXIBLE GLASS FIBER DUCTWORK INSULATION SCHEDULE

CONCEALED DUCTWORK	THICKNESS (mm)	FINISH
Exhaust Ducts Within 3 m of Exterior Openings	38 mm	Factory Jacket
Return Air Ducts & Plenums	51 mm	Factory Jacket
Supply Air Plenums	51 mm	Factory Jacket
Supply Ducts	51 mm	Factory Jacket

3.8 RIGID GLASS FIBER DUCTWORK INSULATION SCHEDULE

EXPOSED DUCTWORK	THICKNESS (mm)	FINISH *
Combustion Air Duct	38 mm	Aluminum Jacket
Exhaust Ducts Within 3 m of Exterior Openings	38 mm	Aluminum Jacket
Exhaust Ducts Exposed to Outdoor Air	38 mm	Aluminum Jacket
Outside Air Intake Ducts	38 mm	Aluminum Jacket
Return Air Ducts and Plenums	51 mm	Aluminum Jacket
Supply Air Plenums	51 mm	Aluminum Jacket
Supply Ducts	51 mm	Aluminum Jacket
Relief Ducts in Mechanical Rooms	38 mm	Aluminum Jacket

* Provide factory-applied jacket only where ductwork is exposed above 3 m above finished floor.

END OF SECTION

SECTION 15330

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 135	(1993) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1990) Carbon Steel Tract Bolts and Nuts
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 795	(1995) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B18.2.1	(1981; Supple 1991; R 1992) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-10062JU	(1992) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(1995; Supple I; Supple II; Supple III) Approval Guide

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanges and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1996) Installation of Sprinkler Systems
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 1963	(1993) Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL-01	(1996) Building Materials Directory

UL-04 (1996; Supple) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation.

1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge the density as indicated on drawings over the hydraulically most demanding 279 square meters of floor area. The minimum pipe size for branch lines in gridded systems shall be 32 mm (1-1/4 inch). Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

1.2.1.1 Hose Demand

An allowance for exterior hose streams shall not be added to the sprinkler system demand.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply as indicated on the drawings. Water supply shall be presumed available at the base of the riser. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing.

1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed limits specified in NFPA 13.

1.3 SUBMITTALS

Submittals related to system configuration, hydraulic calculations, and equipment selection, including manufacturer's catalog data, working drawings, connection drawings, control diagrams and certificates shall be submitted concurrently as a complete package. The package will be reviewed by the U.S. Army Engineer District Fire Protection Engineer. The following shall be submitted in accordance with Section 15010:

Load Calculations for Sizing Sway Bracing

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Sprinkler System Equipment

Manufacturer's Catalog Data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

Sprinkler System Shop Drawings

Detail drawings conforming to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1:100 which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Drawings

As-built drawings, no later than 14 working days after completion of the Final Tests. The sprinkler system shop drawings shall be updated to reflect as-built conditions after work is completed and shall be on reproducible full-size mylar film.

Test Procedures

Proposed test procedures for piping hydrostatic test, testing of alarms, at least 14 days prior to the start of related testing.

Preliminary Tests

A schedule of preliminary tests, at least 14 days prior to the proposed start of the tests.

Final Test

Upon successful completion of tests specified under PRELIMINARY TESTS, written notification shall be given to the Contracting Officer of the date for the final acceptance test. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Submittal Preparer's Qualifications

The name and documentation of certification of the individual who will prepare the submittals, prior to the submittal of the drawings and hydraulic calculations.

Contractor's Material & Test Certificates

Certificates, as specified in NFPA 13, shall be completed and signed by the Contractor's Representative performing required tests for both underground and aboveground piping.

Sprinkler System

Manuals shall be in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures possible breakdowns, and repairs, and troubleshooting guide. This shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

1.4 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software specifically designed for fire protection system design. Software which uses k-factors for typical branch lines is not acceptable. Calculations shall be taken back to the water supply source unless water supply data is otherwise indicated. Calculations shall substantiate that the design area indicated is the hydraulically most demanding. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being

used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.5 SUBMITTAL PREPARER'S QUALIFICATIONS

The sprinkler system submittals, including as-built drawings, shall be prepared by an individual who is either a registered professional engineer or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014.

1.6 INSTALLER QUALIFICATIONS

The installer shall be experienced and regularly engaged in the installation of the type and complexity of system included in this project. A statement prior to submittal of any other data or drawings, that the proposed sprinkler system installer is regularly engaged in the installation of the type and complexity of system included in this project shall be provided. In addition, data identifying the location of at least three systems recently installed by the proposed installer which are comparable to the system specified shall be submitted. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

1.7 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. All requirements that exceed the minimum requirements of NFPA 13 shall be incorporated into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.8 DELIVERY AND STORAGE

Equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust or other contaminants.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.1.2 Requirements for Fire Protection Service

Equipment and materials shall have been tested by Underwriters Laboratories, Inc. and listed in UL-04 or approved by Factory Mutual and listed in FM P7825. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL-04 or FM P7825.

2.1.3 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

2.2 UNDERGROUND PIPING SYSTEMS

2.2.1 Pipe

Piping from a point 150 mm above the floor to a point 1500 mm outside the building wall shall be ductile iron with a rated working pressure of 1034 kPa conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 1500 mm outside the building walls shall comply with Division 2 work.

2.2.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

2.3 ABOVEGROUND PIPING SYSTEMS

Aboveground piping shall be steel.

2.3.1 Steel Piping System

2.3.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.3.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa (175 psi) service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall

be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.3.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm (1/16 inch) thick, and full face or self-centering flat ring type. Bolts shall be squarehead conforming to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 Pipe Hangers

Hangers shall be listed in UL-04 or FM P7825 and of the type suitable for the application, construction, and pipe type and sized involved.

2.3.5 Valves

2.3.5.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL-01 or FM P7825.

2.3.5.2 Check Valve

Check valve 50 mm (2 inches) and larger shall be listed in UL-01 or FM P7825. Check valves 100 mm (4 inches) and larger shall be of the swing type with flanged cast iron body and flanged inspection plates, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.4 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.5 WATER MOTOR ALARM ASSEMBLY

Assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 20 mm galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 25 mm galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.

2.6 ALARM INITIATING AND SUPERVISORY DEVICES

2.6.1 NOT USED

2.6.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm,

SPDT snap action switches and a 15 mm NPT male pipe thread. The switch shall have a maximum service pressure rating of 1207 kPa. There shall be two SPDT (Form C) contacts factory adjusted to operate at 28 to 55 kPa. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.6.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.7 FIRE DEPARTMENT CONNECTION

Fire department connection shall be flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 65 mm diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.8 SPRINKLERS

Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13.

2.8.1 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 12.7 mm or 13.5 mm orifice.

2.8.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, semi-recessed type with nominal 12.7 mm or 13.5 mm orifice. Pendent sprinklers shall have a polished chrome finish.

2.8.3 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 12.7 mm orifice. Sidewall sprinkler shall have a polished chrome finish.

2.8.4 NOT USED

2.8.5 NOT USED

2.8.6 NOT USED

2.9 DISINFECTING MATERIALS

2.9.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.9.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.10 ACCESSORIES

2.10.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.10.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 20 mm and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.10.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.10.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located in tool rooms, workshops, storage, chemical and battery rooms.

2.10.5 Identification Sign

Valve identification sign shall be minimum 150 mm wide x 50 mm high with enamel baked finish on minimum 1.214 mm steel or 0.6 mm aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein.

3.2 ABOVEGROUND PIPING INSTALLATION

Piping shall be run straight and bear evenly on hangers and supports.

3.2.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection of the piping system shall be provided in accordance with NFPA 13 and Appendix A, with the exception that the "Earthquake Zones" map of Appendix A shall not apply to this project. Seismic protection shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required in NFPA 13 for protection of piping against

damage from earthquakes. Branch lines shall be equipped with sway braces at the end sprinkler head and at intervals not exceeding 9 m .

3.2.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.2.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.2.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 25 mm pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 300 mm. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 25 mm below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 100 mm. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.2.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 150 mm from ceiling grid.

3.2.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 750 mm in length shall be individually supported.

3.2.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

3.2.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing

fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 15 mm (1/2 inch).

3.2.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section Division 1. In penetrations which are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement which will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.2.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.2.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 25 mm pipe connected to the remote branch line; a test valve located approximately 2 meters above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.2.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

3.2.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 900 mm above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.2.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.3 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 900 mm. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 1500 mm outside the building walls shall meet the requirements of Division 2.

3.4 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02221 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

3.5 ELECTRICAL WORK

Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 16721 FIRE DETECTION AND ALARM SYSTEM. Wiring color code shall remain uniform throughout the system.

3.6 STERILIZATION

After system components have been installed and pressure tested, each portion of the completed system shall be sterilized. After pressure tests have been made, the portion to be sterilized shall be thoroughly flushed with water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump, shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall be then flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in properly sterilized containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-10062JU. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilization shall be repeated until tests indicate the

absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.7 FIELD PAINTING AND FINISHING

Field painting and finishing are specified in Section 09900 PAINTING, GENERAL.

3.8 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.8.1 Underground Piping

3.8.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

3.8.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 1.89 liters per hour per 100 gaskets or joints, regardless of pipe diameter.

3.8.2 Aboveground Piping

3.8.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa or 350 kPa in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.8.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph

SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.9 FINAL ACCEPTANCE TEST

A technician employed by the installing Contractor shall be present for the final tests and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

-- End of Section --

SECTION 15355

AQUEOUS FILM-FORMING FOAM (AFFF) FIRE PROTECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1981; R 1993) Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 312/A 312M	(1995a) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 351/A 351M	(1994a) Castings, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 403/A 403M	(1996) Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 795	(1996) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Gray Iron Threaded Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME BPV VIII Div 1	(1995; Addenda Dec 1995, Dec 1996) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA ANSI/AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA ANSI/AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA ANSI/AWWA C151/A21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits

MILITARY SPECIFICATIONS (MS)

MS MIL-F-24385	(Rev F; Am 1) Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, For Fresh and Sea Water

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 11	(1994) Low Expansion Foam
NFPA 13	(1996; Errata 13-96-1) Automatic Sprinkler Systems
NFPA 16	(1995) Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 16A	(1994) Installation of Closed-Head Foam-Water Sprinkler Systems
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 70	(1996; Errata 96-4) National Electrical Code
NFPA 72	(1996; Errata Oct 96, Dec 96, TIA 96-1, 93-2, 96-3) National Fire Alarm Code
NFPA 1963	(1993) Fire Hose Connections

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	(1997) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

The system shall consist of an automatic wet-pipe foam-water fire protection system and shall be provided for the areas indicated on the drawings. Except as modified herein, the system shall meet the requirements of NFPA 11, NFPA 13, NFPA 16, NFPA 16A, NFPA 24 and NFPA 72.

1.3 SYSTEM OPERATIONAL FEATURES

The wet-pipe sprinkler system shall operate such that actuation of a single sprinkler will cause water to flow through the alarm check valve, foam concentrate to enter the affected proportioners, and foam-water solution to be discharged from actuated sprinklers.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES.

SD-01 Data

AFFF System Equipment; GA.

Manufacturer's catalog data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list with equipment description, model number, and quantity shall be provided.

Spare Parts; GA.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

SD-04 Drawings

AFFF System; GA.

Detail drawings shall conform to the requirements prescribed in NFPA 13and shall be 841 x 594 mm. Drawings shall include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.

b. Floor plans drawn to a scale not less than 1:100 clearly showing locations of devices, equipment, risers, electrical power connections, flame detector viewing areas, areas covered by each nozzle, and other details required to clearly describe the proposed arrangement.

c. Piping plan for each individual sprinkler system. Sprinklers and associated piping shall be shown. Abbreviated presentation forms will not be accepted. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be identified. A separate plan shall be provided for each overhead

sprinkler system.

d. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; and from sprinkler feed mains, crossmains and branchlines to finished floor and roof or ceiling.

e. Location of supervisory switches, solenoids, notification appliances, and other electrical devices. In addition, conduit routing and sizes, and the number of conductors contained in each shall be indicated.

f. Longitudinal and transverse building sections showing typical branch line and crossmain pipe routing and elevation of each typical sprinkler above finished floor.

g. Equipment room layout drawings drawn to a scale of not less than 1:20 to show details of each system component, clearances between each other and from other equipment and construction in the room.

h. Details of each type of pipe hanger, sway bracing for earthquake protection, restraint of underground water main at point-of-entry into the building, proportioners, and mounting details, AFFF system control valve header and related components.

i. Connection drawings and control diagrams indicating overall electrical and mechanical operation of the AFFF system. This shall include identification and operation of each major component of the system. Diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate control panel wiring and make and model of devices and equipment connected thereto.

As-built Drawings; FIO.

One set of reproducible and six copies, within 14 calendar days after successful completion of required testing. A separate set of approved submittal drawings of the overall system, marked up to indicate as-built conditions, shall be maintained on site. These drawings shall be maintained in a current condition at all times and shall be made available for review immediately upon request during normal working hours. Variations from the approved drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials, and/or required for coordination between trades shall be indicated in sufficient detail to accurately reflect the as-built conditions.

SD-06 Instructions

AFFF System; FIO.

A copy of the proposed diagrams and instructions for the overall AFFF system, prior to posting.

SD-08 Statements

Contractor Qualifications; GA.

Data approved, prior to submittal of any other data or drawings, to substantiate that the proposed installer is regularly engaged in the

installation of the type and complexity of fire protection system included in this project. Data shall identify the location of three systems recently installed by the proposed installer which are comparable to the system specified. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

Final Acceptance Test Plan; GA.

Details of method proposed for required tests at Final Acceptance, including step-by-step procedures; list of equipment to be used; names, titles, and affiliations and qualifications of personnel who will participate in the tests; methods for protecting the facility and equipment during testing; means for containing the AFFF solution during discharge tests; and proposed means for disposal. Blank forms the Contractor plans to use to record test results shall be included.

SD-09 Reports

Tests; GA.

Reports for tests, as follows:

a. Reports as outlined in NFPA 13 documenting results of flushing and hydrostatic tests.

b. Trip tests of alarm check and automatic water control valves.

c. Test report of AFFF concentrate proportioning system. Report shall include conductivity readings for foam samples taken from each AFFF proportioner. Report shall be signed by the factory-trained technical representative employed by the AFFF concentrate manufacturer.

d. Test report of the fire alarm panel and initiating and indicating devices. Report shall include a unique identifier for each device with an indication of test results. Report shall be signed by the factory-trained technician of the control panel manufacturer.

e. Videotapes of tests specified to be recorded.

SD-13 Certificates

Contractor's Material and Test Certificates; GA.

Certificates from manufacturers to substantiate that components, equipment and material proposed for installation and use meet requirements as specified, concurrent with submittal of manufacturer's catalog data of equipment proposed for installation. Certificates shall be on a form for this purpose or on official letterhead of the manufacturer with specified information stated as required. Certificate shall be signed by an officer of the corporation. Certificates shall be provided for the following:

a. AFFF concentrate. Certification that AFFF concentrate proposed for use has been tested and is in compliance with MS MIL-F-24385.

b. AFFF concentrate control valve. Certification that valve is designed, constructed and will function as specified.

SD-19 Operation and Maintenance Manuals

AFFF System; GA.

Manuals in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures, possible breakdowns, and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout, and simplified wiring and control diagrams for the system as installed. The manuals shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

1.5 REGULATORY REQUIREMENTS

The advisory provisions of NFPA standards and recommended practices specified shall be considered mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In the event of a conflict between referenced NFPA standards and this specification, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 REQUIREMENTS FOR FIRE PROTECTION SERVICE

All equipment and material shall have been tested by Underwriters Laboratories, and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

2.3 PRESSURE RATINGS

Valves, fittings, couplings, proportioners, alarm switches, strainers, and similar devices shall be rated for the maximum working pressures that can be experienced in the system, but not less than 1200 kPa (175 psi).

2.4 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

2.5 UNDERGROUND PIPING SYSTEMS

Pipe shall be ductile iron pipe conforming to AWWA ANSI/AWWA C151/A21.51, working pressure not less than 1034 kPa (150 psi), with cement-mortar

lining conforming to AWWA ANSI/AWWA C104/A21.4 for piping under the building and to a point 1.5 m (5 feet) outside the building walls. Fittings shall be ductile iron conforming to AWWA ANSI/AWWA C110/A21.10. Piping more than 1.5 m (5 feet) outside the building walls shall be provided under Section 02660 WATER DISTRIBUTION SYSTEM.

2.6 ABOVEGROUND PIPING SYSTEMS HANDLING WATER OR AFFF SOLUTION

2.6.1 Pipe

Pipe shall be standard weight conforming to ASTM A 795 or ASTM A 53. Pipe 150 mm (6 inch) diameter and smaller shall be Schedule 40. Pipe shall be marked as to the brand or name of the manufacturer, kind of pipe and the ASTM designation in accordance with the "Product Marking" provisions of the ASTM standard.

2.6.2 Non-Grooved Fittings

Non-grooved fittings shall be threaded or flanged. Threaded fittings shall be cast iron conforming to ASME B16.4 or malleable iron conforming to ASME B16.3. Flanged fittings shall be cast iron conforming to ASME B16.1. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which require drilling a hole in the pipe, and fittings which use steel gripping devices to bite into the pipe shall not be used.

2.6.3 Grooved Fittings and Couplings

Grooved fittings shall not be used.

2.6.4 Flanges and Gaskets

Flanges shall conform to NFPA 13 and ASME B16.1. Flanges shall be the type that are welded or threaded to the pipe. Flanges which are bolted to grooved pipe will not be permitted. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 2.0 mm thickness, full face or self-centering flat ring type.

2.6.5 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and be of the type suitable for the application, construction and size pipe involved.

2.6.6 Control Valve

Valves shall be indicating type in accordance with NFPA 13. Valves 65 mm (2-1/2 inch) and larger shall be flanged outside screw and yoke (OS&Y) type.

2.6.7 Check Valve

Check valves 100 mm (4 inches) and larger shall be flanged, swing type, cast or ductile iron body and cover, cast or ductile iron clapper with replaceable EPDM rubber facing. Valves shall be suitable for either vertical or horizontal mounting and equipped with a removable handhole cover. The direction of flow shall be indicated by an arrow cast in the valve body. The valve body shall include plugged pipe thread connections for a 50 mm (2 inch) drain.

2.7 ABOVEGROUND PIPING SYSTEMS HANDLING AFFF CONCENTRATE

2.7.1 Pipe

Pipe shall be standard weight stainless steel conforming to ASTM A 312/A 312M, Grade TP 304L.

2.7.2 Fittings

Fittings shall be seamless socket weld type or flanged type and of material conforming to ASTM A 403/A 403M, Grade WP 304L, and shall be compatible with pipe.

2.7.3 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and be of the type suitable for the application, construction and size pipe involved.

2.7.4 Control Valves

Valve shall be full port ball type with operating handle that indicates the on/off position of the valve. Unit shall be socket weld or flanged type. Valve body and ball shall be of 316 stainless steel complying with ASTM A 351/A 351M.

2.8 ALARM CHECK VALVE ASSEMBLY

Alarm check valve assembly shall be of the variable pressure type. Assembly shall be provided with standard trimmings including pressure gauges, retarding chamber, alarm line vent, testing bypass, and necessary pipe, fittings, and accessories required for a complete installation. Alarm valve trim shall have separate valves for "alarm test" and "alarm shutoff."

2.9 NOT USED

2.10 ALARM DEVICES

2.10.1 Water Motor Alarm Assembly

Assembly shall include a body housing, impeller wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 20 mm (3/4 inch) galvanized piping shall be provided between the housing and the alarm line trim. Drain piping from the body housing shall be minimum 25 mm (1 inch) galvanized steel and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and on the outside surfaces.

2.10.2 Waterflow Pressure Alarm Switch

Unit shall include a 15 mm (1/2 inch) NPT male pipe thread, two 15 mm (1/2 inch) conduit knockouts, and two sets of SPDT (Form C) contacts. The switches shall be factory adjusted to transfer the contacts at 27.6 to 55.1 kPa (4 to 8 psi) on rising pressure. Unit shall include a water-tight NEMA 4 diecast aluminum housing with a tamper resistant cover which requires a special key for removal. The cover shall be provided with a tamper switch which shall operate upon removal of the cover. Units used on wet-pipe systems shall have an adjustable, instantly recycling pneumatic retard to

prevent false alarms due to water pressure variation. Retard adjustment shall be factory set at approximately 20-40 seconds and adjustable between 0-90 seconds.

2.11 FIRE DEPARTMENT CONNECTION

Connection shall be projecting type with cast brass body, a chromium plated finish, and matching wall escutcheon lettered "Auto Spkr". The connection shall have two inlets with individual self-closing clappers, caps with drip drains, and chains. Female inlets shall have 65 mm (2-1/2 inch) diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.12 NOT USED

2.13 NOT USED

2.14 DISCHARGE DEVICES

2.14.1 Sprinkler

Sprinkler shall be 12.7 mm (1/2 inch) orifice spray type. For wet-pipe systems, sprinkler shall be upright type with quick response glass bulb heat responsive and actuating element having a temperature rating of 80 degrees C (175 degrees F). Spare sprinklers in accordance with NFPA 13 shall be housed in metal or plastic containers.

2.15 AFFF LIQUID CONCENTRATE

AFFF concentrate shall be 3 percent conforming to MS MIL-F-24385. Concentrate shall be the product of one manufacturer. Mixing of non-identical brands of concentrate will not be permitted.

2.16 DIAPHRAGM TANK BALANCED PRESSURE PROPORTIONING SYSTEM

Tank shall be a steel pressure vessel constructed in accordance with ASME BPV VIII Div 1. ASME label shall be permanently affixed to the tank. Tank shall be horizontally mounted on steel saddles and shall contain a full internal diaphragm (bladder) having a minimum capacity of 3786 L (1000 gallons). Diaphragm shall be nylon-reinforced Buna-N rubber or other approved material conforming to the inside shape of the tank. AFFF concentrate shall be stored inside the diaphragm and the concentrate shall not be in contact with the steel tank. The tank shall have perforated PVC tubes installed inside the diaphragm to assure full displacement of the stored concentrate. Tank shall be equipped with the manufacturer's standard fittings and trim, including AFFF fill and drain connections, water fill and drain connections, and concentrate sight gauge.

2.17 NOT USED

2.18 BALANCED PRESSURE PROPORTIONER (RATIO CONTROLLER)

The proportioner shall be a standard balanced pressure type unit capable of proportioning AFFF liquid at 3 percent, (3 parts concentrate to 97 parts water by volume solution) at flow rates within the flow range of the proportioner. Major components of the proportioner, including the body, inlet nozzle and metering orifice shall be of brass, bronze or stainless steel. The body shall be clearly marked with a flow-direction arrow, and the type and percent of AFFF concentrate that it was designed to proportion. The proportioner size shall be 150 mm (6 in) and shall have a

maximum friction loss of 62 kPa (9 psi) at a flow rate of 170 L/second (2694 gpm). The proportioner shall be factory assembled and tested as an assembly by one manufacturer. Field disassembly or assembly of any component part will not be accepted. Components shall be of the make/model required by the specific UL listing or FM approval.

2.19 AFFF CONCENTRATE CONTROL VALVE ASSEMBLY

Assembly shall control AFFF concentrate to proportioners and shall be arranged to open upon application of water or AFFF solution pressure from the alarm check or automatic water control valve to which it is connected. Assembly shall include a full port ball valve, actuating cylinder, wye strainer at the water inlet port and an actuating cylinder vent valve. Valve components shall be brass, bronze or stainless steel. Valve shall be operable with water inlet pressure as low as 207 kPa (30 psi).

2.20 NOT USED

2.21 NOT USED

2.22 NOT USED

2.23 VALVE SUPERVISORY (TAMPER) SWITCH

Switch shall be designed to monitor the open condition of each water or AFFF concentrate control valve to which it is mounted. The switch shall include a cast aluminum housing, tamperproof cover, two sets of single pole, double throw (SPDT) contacts and brackets and J-bolts needed for mounting. Removal of the cover shall cause both switches to operate.

2.24 NOTIFICATION APPLIANCES

Notification appliances shall be suitable for connection to supervised alarm indicating circuits. Appliance shall have a separate screw terminal for each conductor.

2.24.1 Electronic Signaling Device

Device shall be surface-mounted type which can be mounted to a standard 100 mm (4 inch) square backbox. Device shall be provided with three field-selectable sounds (horn, warble, siren) and three sound output levels to 102 DBA in an anechoic chamber at 3 m. The device shall be equipped with a 70,000 peak candela (candlepower) strobe light with white polycarbonate lenses with FIRE lettering which operates independently or in parallel with the audible output. Electronic device shall operate on nominal 24 VDC, shall be polarized for line supervision and shall have screw terminals for in-out wiring.

2.24.2 Alarm Horn

Horn shall be surface mounted, with the matching mounting back box surface mounted. Horns shall operate on nominal 24 VDC and have screw terminals for in-out wiring connection. Sound output shall be a minimum of 85 DBA at 3 m. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grills.

2.24.3 Alarm Bell

Bell shall be surface mounted vibrating type with matching back box. Sound output shall be a minimum of 85 DBA at 3 m. Unit shall operate on nominal 24 VDC. Unit shall have screw terminals for in-out wiring connection. Bells used in exterior locations shall be specifically listed or approved for outdoor use and shall be provided with metal housing and protective grilles.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Aboveground Piping

Piping shall be installed straight and bear evenly on hangers and supports. Piping shall be concealed in areas with suspended ceiling and shall be inspected, tested and approved before being concealed.

3.1.1.1 Joints

Pipe joints shall conform to NFPA 13. Not more than four threads shall show after joint is made up. Joint compound shall be applied to male threads only. Joints shall be faced true, provided with gaskets and made square and tight. Flanged joints shall be provided where indicated or required by NFPA 13.

3.1.1.2 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 10 mm (1/2 inch).

3.1.1.3 Sprinkler Riser Nipples (Sprigs)

One-inch riser nipples (sprigs) between sprinkler branch lines and individual sprinklers shall not be used unless necessitated by roof or ceiling conditions. In such cases, fittings shall not be installed between the branch line tee and the reducing coupling below the sprinkler.

3.1.1.4 Sprinkler Deflectors

Sprinkler deflectors shall be installed parallel to the roof or ceiling. Deflector distances from the underside of the roof or ceiling shall be in accordance with NFPA 13 except that the distance shall not exceed 300 mm (12 inches). Sprinkler clearances from obstructions shall be in accordance with NFPA 13.

3.1.1.5 Pipe Supports and Hangers

Installation methods outlined in NFPA 13 are mandatory. Protection of piping against damage from earthquakes shall be provided. Longitudinal and lateral sway bracing shall be provided for piping 65 mm (2-1/2 inch) diameter and larger.

3.1.1.6 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes penetrating concrete or masonry walls or concrete floors shall be provided with pipe sleeves fitted into place at the time of construction through its respective wall or floor, and shall be cut flush with each surface. Sleeve sizes and clearance between pipe and sleeve shall be in accordance with NFPA 13. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section 07270FIRESTOPPING.

3.1.1.7 Piping Pitch

Piping shall be pitched to the main drain or to auxiliary drains provided as required to facilitate draining. Branch lines shall be pitched at least 4 mm in 1 m (1/2 inch in 10 feet) and crossmains and feedmains shall be pitched to at least 2 mm in 1 m (1/4 inch in 10 feet).

3.1.1.8 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe and shall be chromium-plated iron or chromium-plated brass, either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.1.1.9 Drains

Main drain piping shall be provided to discharge at safe points outside each building. Drains shall be of adequate size to readily receive the full flow from each drain under maximum pressure. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, the branch lines shall be manifolded to a common drain line. Each drain valve shall be provided with a metal sign identifying the type of drain connection or function of the valve.

3.1.1.10 Identification Signs

Signs shall be in accordance with NFPA 13. Properly lettered and approved metal signs shall be suitably affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate.

3.1.2 Underground Piping

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 1 m (3 feet). The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm (6 inches) above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be coated with a bituminous material.

3.2 EXCAVATION, TRENCHING AND BACKFILLING

Earthwork shall be performed in accordance with applicable provisions of Section 02221 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

3.3 ELECTRICAL WORK

Unless otherwise specified, power supply equipment and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Overcurrent and Surge Protection

Equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. Cables and conductors which serve as communication links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.3.2 Grounding

Grounding shall be provided to building ground.

3.3.3 Wiring

System field wiring shall be installed in 20 mm (3/4 in.) minimum diameter electrical metallic tubing or metallic conduit. Wiring for the sprinkler system fire detection and control system shall be installed in tubing or conduits dedicated for that use only and shall not be installed in conduit, outlet boxes or junction boxes which contain lighting and power wiring or equipment. Circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked and labeled in accordance with the wiring diagram. No more than one conductor shall be installed under any screw terminal. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors is not permitted. Wiring within any control equipment shall be readily accessible without removing any component parts. Conductors shall be color coded and shall be identified within each enclosure where a connection or termination is made. Conductor identification shall be by plastic coated, self-sticking, printed markers, or by heat-shrink type sleeves. Circuits shall be wired to maintain electrical supervision so that removal of any single wire from any device shall cause a "trouble" condition on the control panel.

3.3.4 NOT USED

3.3.5 NOT USED

3.3.6 NOT USED

3.3.7 Notification Appliances

Notification appliances shall be mounted a minimum of 2400 mm above the finished floor unless limited by ceiling height.

3.4 PIPE PAINTING AND LABELLING

3.4.1 Painting

Black steel pipe shall be painted in accordance with the requirements specified under Section 09900 PAINTING, GENERAL. Pipe in equipment rooms

shall be painted red. Pipe in other areas shall be painted to match finishes in those areas. Stainless steel pipe shall not be painted.

3.4.2 Pipe Identification

Aboveground pipe 50 mm (2 inch) diameter and larger shall be identified with legends. Legends shall include FOAM CONCENTRATE, FOAM-WATER SPRINKLER and FIRE PROTECTION WATER. Legends shall utilize WHITE letters on a RED color field and shall include arrows to indicate the direction of flow. Length of color field, letter size and locations on piping shall be as recommended in ANSI A13.1.

3.5 PRELIMINARY TESTS

The fire protection system shall be tested to assure that equipment, components and subsystems function as intended. Preliminary tests shall be videotaped to record the methods and equipment employed to conduct the tests. Tests shall be videotaped from start to finish with a video camera which records the date and time lapse (in seconds).

3.5.1 Flushing

Underground water mains shall be flushed in accordance with NFPA 13 and NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the maximum water demand rate of the system.

3.5.2 Hydrostatic Tests

The underground and aboveground piping systems, including AFFF concentrate, shall be hydrostatically tested in accordance with NFPA 13 at not less than 1379 kPa (200 psi), or 345 kPa (50 psi) in excess of maximum system operating pressure, for 2 hours. There shall be no visible leakage from the piping when the system is subjected to the hydrostatic test.

3.5.3 Alarm Check and Automatic Water Control Valves

Each valve shall be tested to verify operation in accordance with manufacturer's published operating instructions. This shall include tests of valves and switches connected thereto.

3.5.4 NOT USED

3.5.5 AFFF Concentrate System

Tests shall be conducted under the supervision of a technician trained and certified by the AFFF concentrate manufacturer. The complete AFFF concentrate system shall be adjusted and tested to assure proper operation. Testing shall include, but not be limited to, the following:

a. Filling the AFFF concentrate tank.

b. Adjustment of control valves, proportioners.

c. Collection of AFFF samples and testing with a conductivity meter to verify proportioning accuracy.

d. Testing low liquid level alarms.

e. Other operational checks recommended by the AFFF proportioner manufacturer.

3.5.6 Control System Tests

Tests shall be conducted under the supervision of a factory-trained representative of the fire alarm panel manufacturer. The electrical control system shall be tested to verify that the control panel and all wiring have been installed correctly and that all components function as intended. Tests shall be conducted using normal operating and battery power. Testing shall include, but not be limited to, each of the following:

a. Alarm initiating circuit and device, including waterflow and pressure switches, and similar devices connected to the control panel.

b. Supervisory circuit and device, including valve supervisory (tamper) switches, low liquid level in foam concentrate tank, and similar circuits and devices.

c. Actuation circuit and device, including circuits fire pumps, and similar circuits related to system activation.

d. Annunciator lamp and notification appliance, including bells, horns, electronic signaling, and similar devices.

3.6 FINAL TEST

3.6.1 Requirements

The Final Test shall be a repeat of Preliminary Tests, except that flushing and hydrostatic tests shall not be repeated. In addition, the system shall be automatically actuated and allowed to discharge for a period of at least one minute prior to shutting the system off. The Contractor shall correct system failures and other deficiencies identified during testing and shall retest portions of the system affected by the required corrections.

3.6.1.1 Pretest Requirements

The system will be considered ready for final testing only after the following have been accomplished.

a. The required test plan has been submitted and approved.

b. Preliminary tests have been made and deficiencies determined to have been corrected to the satisfaction of the equipment manufacturer's technical representatives and the Contracting Officer.

c. Test reports, including the required videotape of the preliminary tests, have been submitted and approved.

d. The fire alarm panels and detection systems shall have been in service for a break-in period of at least 14 consecutive days prior to the final test.

e. The Contractor has provided written notification to the Contracting Officer, at least 21 days prior to date of Final Test, that preliminary tests have been successfully completed.

3.6.1.2 Videotaping

Contractor shall videotape the tests in VHS format and shall record the date and time-lapse, in seconds, from start to finish of each portion of the test as directed by the Contracting Officer. Four copies of the tape shall be submitted before the system will be considered accepted.

3.6.1.3 Manufacturer's Services

Experienced technicians regularly employed by the Contractor in the installation of the system and manufacturer's representative referred to elsewhere in this specification shall conduct the testing.

3.6.1.4 Materials and Equipment

Contractor shall provide AFFF concentrate, gauges, AFFF sample collection apparatus, instruments, hose, personnel, elevating platforms, scaffolding, ladders, appliances and any other equipment necessary to fulfill testing requirements specified.

3.6.1.5 Facility and Environmental Protection

Contractor shall provide protection for the facility, including electrical and mechanical equipment exposed to possible damage during discharge tests. This shall include provision of sandbags or similar means for preventing migration of foam solution into adjacent areas. Temporary measures shall be provided to prevent AFFF solution from entering storm drains, sanitary sewers, drainage ditches, streams and other water sources. Discharged AFFF shall be contained in portable tank trucks for removal as part of this contract.

3.6.2 Control System Tests

Operational features of the control system shall be tested and demonstrated. This shall include testing of control panels and each input and output circuit. Tests of circuits shall include actuation and simulated circuit fault at each initiating, notification, supervisory and actuation device or appliance. As a practical matter, these tests shall be a repeat of preliminary tests required under paragraph PRELIMINARY TESTS.

3.6.3 AFFF Proportioning System Tests

Each AFFF proportioner (ratio controller) shall be flow tested to determine that proportioning accuracy is within specified limits. Each proportioner supplying sprinkler systems with closed heads shall be tested at two flow rates; the minimum flow rate specified in the manufacturer's published data and a flow rate at least four times the minimum. Collecting AFFF samples from each proportioner shall be accomplished in accordance with NFPA 16A and the approved test plan. Foam solution concentrations shall be determined using the methods outlined in NFPA 16A. Proportioning for nominal 3 percent concentrate shall be between 3 percent and 4 percent. If test results indicate proportioning below or above this range, the Contractor shall make necessary adjustments and retest as directed by the Contracting Officer.

3.6.4 Post-discharge Test Requirements

Following the successful completion of the tests, the Contractor shall

remove the foam solution from the site as indicated on the approved AFFF waste containment and disposal plan. Contractor shall replenish AFFF concentrate consumed during the tests. The entire fire protection system shall be returned to automatic operation and the facility restored to operational capability. Discharged solution shall be contained and disposed of in a manner acceptable to local authorities and as identified on the approved test plan. Once tests are completed, systems shall be returned to fully operational status, including filling of AFFF concentrate tanks with concentrate and filling of solution piping with premix as required.

3.7 POSTED INSTRUCTIONS

Framed description of system operation, instructions and schematic diagrams of the overall AFFF system and each subsystem, shall be posted where directed. Condensed operating instructions explaining the system for normal operation, refilling the AFFF storage tank, and routine testing shall be included.

3.8 TRAINING

Contractor shall provide at least two training sessions of at least 6 hours each to explain system's operation and maintenance. Training sessions shall be conducted on alternate days to afford flexibility by shift personnel and other attendees. Training sessions shall include classroom instruction and explanation of approved Operation and Maintenance Manuals. Training aids shall be provided as necessary to clearly describe the systems. In addition to classroom instruction, systems shall be operated to provide hands-on demonstrations. Contractor shall include a system actuation using water only, to demonstrate system operation and procedures for resetting the system. Training areas will be provided by the Government in the building where the systems are installed. Dates and times of the training sessions shall be coordinated with the Contracting Officer not less than 15 calendar days prior to the first session.

-- End of Section --

SECTION 15410 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings.

B. Valves.

C. Sanitary sewer piping system.

D. Domestic water piping system.

E. Natural gas piping system.

1.2 REFERENCES

A. ANSI B31.1 - Power Piping

B. ANSI B31.2 - Fuel Gas Piping

C. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems

D. ANSI B31.9 - Building Service Piping

E. ASME - Boiler and Pressure Vessel Code

F. ASME Sec. 9 - Welding and Brazing Qualifications

G. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800

H. ASME B16.3 - Malleable Iron Threaded Fittings

I. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and

250

J. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings

K. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings

L. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV

M. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes

N. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

O. ASME B16.32 - Cast Copper Alloy Solder-Joint Fittings for Solvent Drainage Systems

P. ASTM A47 - Ferritic Malleable Iron Castings

Q. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless

R. ASTM A74 - Cast Iron Soil Pipe and Fittings

S. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

T. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

U. ASTM B32 - Solder Metal

V. ASTM B42 - Seamless Copper Pipe

W. ASTM B43 - Seamless Red Brass Pipe

X. ASTM B75 - Seamless Copper Tube

Y. ASTM B88 - Seamless Copper Water Tube

Z. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube

AA. ASTM B302 - Threadless Copper Pipe (TP)

AB. ASTM B306 - Copper Drainage Tube (DMV).

AC. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe

AD. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings

AE. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

AF. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings

AG. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

AH. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings

AI. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)

AJ. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

AK. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings

AL. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

AM. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping

AN. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pipe

AO. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

AP. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

AQ. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.

AR. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

AS. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

AT. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

AU. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AV. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

AW. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Pipe

AX. AWS A5.8 - Brazing Filler Metal

AY. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids

AZ. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.

BA. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings

BB. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

BC. AWWA C651 - Disinfecting Water Mains

BD. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems

BE. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems

BF. CAN-3 B281 - Aluminum Drain, Waste, and Vent Pipe and Components

BG. NCPWB - Procedure Specifications for Pipe Welding

BH. NFPA 54 - National Fuel Gas Code

BI. NFPA 58 - Storage and Handling of Liquified Petroleum Gases

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of valves.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ASME Sec 9 NCPWB Standard Procedure Specifications.

D. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State, Local, SPCC, NFPC, UPC and BOCA plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Accept valves on site in shipping containers with labelling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding are wet or frozen.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 1500 MM OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight

1. Fittings: Cast iron

2. Joints: ASTM C564, neoprene gasket system or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron

2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.3 WATER PIPING, BURIED WITHIN 1500 MM OF BUILDING

A. Copper Tubing: ASTM B88, L hard drawn.

1. Fittings: ASME B16.18, cast bronze or ASTM B16.22 wrought copper and bronze.

2. Joints: ASTM B32, solder, Grade 95TA.

2.4 WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L hard drawn.

1. Fittings: ASME B16.18, cast bronze or ASTM B16.22 wrought copper and bronze.

2. Joints: ASTM B32, solder, Grade 95TA.

2.5 NATURAL GAS PIPING, BURIED WITHIN 1500 MM OF BUILDING

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.

1. Fittings: ASTM A234, forged steel welding type, with AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2. Joints: ANSI B31.2 welded.

2.6 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.

1. Fittings: ASTM b16.3, MALLEABLE IRON OR ASTM 234, forged steel welding type.

2. Joints: NFPA 54, threaded or welded to ANSI B31.1.

2.7 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 50 mm and Under:

1. Ferrous pipe: 1 034 kPa malleable iron threaded unions.

2. Copper tube and pipe: 1 034 kPa bronze unions with soldered joints.

B. Pipe Size Over 50 mm:

1. Ferrous pipe: 1 034 kPa forged steel slip-on

flanges; 1.6 mm thick preformed neoprene gaskets.

2. Copper tube and pipe: 1 034 kPa slip-on bronze flanges; 1.6 mm thick preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.8 BALL VALVES

A. Acceptable Manufacturers
1. Nibco
2. Hammond

B. Up to and including 50 mm: Full port bronze two piece body, chrome plated steel ball, teflon seats and stuffing box ring, lever handle threaded ends with union.

C. Over 50 mm: Cast steel body, chrome plated full port steel ball, teflon seat and stuffing box seals, lever handle.

2.9 SWING CHECK VALVES

A. Manufacturers:

1. Hammond
2. Nibco
3. Grinnell

B. Up to and including 50 mm: Bronze body, bronze swing disc, screwed ends.

C. Over 50 mm: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

2.10 WATER PRESSURE REDUCING VALVES

A. Acceptable Manufacturers:
   1. Watts
   2. Hersey
   3. Febco

B. Up to 50 mm: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded double union ends.

C. Over 50 mm: Cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.11 STRAINERS

A. Acceptable Manufacturers
   1. Watts
   2. Mueller
   3. Wilkins

B. Size 50 mm and Under: Screwed brass or iron body for 1200 kPa working pressure, Y pattern with 0.8 mm stainless steel perforated screen.

C. Size 65 mm to 100 mm: Flanged iron body for 1200 kPa working pressure, Y pattern with 1.2 mm stainless steel perforated screen.

PART 3 EXAMINATION

3.1 EXECUTION

A. Prior to submitting bid, visit the site of the proposed construction and thoroughly investigate existing utilities, working conditions to be encountered etc. No additional compensations shall be allowed for conditions increasing cost which were not known when submitting proposal if the condition was obvious and could have been discovered during a site visit.

3.2 PREPARATION

A. Excavation

1. Perform all excavating as required to make plumbing installation. Establish all lines and elevations prior to opening trenches and be responsible for correctness thereof.

2. Where trenches are excavated to grade such that the bottom of the trench forms the bed for the pipe, a solid and continuous bearing shall be provided between joints, and bell holes shall be provided at points where the pipe is joined, and the pipe shall not be supported on blocks to grade.

3. Where trenches are excavated below grade such that the bottom of the trench does not form the bed for the pipe, the trench shall be backfilled to grade with sand or fine gravel placed in layers of 152 mm maximum depth and compacted after each placement. Where rock is encountered in trenching, it shall be removed to a minimum of 76 mm below the grade line of the trench, and the trench shall be backfilled to grade with sand tamped in place so as to provide a uniform bearing

for the pipe between joints. The pipe shall not rest on rock at any point including the joints.

4. If soft materials of poor bearing qualities are found at the bottom of the trench, stabilization shall be achieved by over excavating a minimum of two pipe diameters and bringing up to grade with fine gravel or crushed stone or a concrete foundation. Such a concrete foundation shall be bedded with sand tamped in place so as to provide a uniform bearing for the pipe between joints.

B. Backfilling

1. Loose earth, free of rocks, broken concrete, frozen chunks and other rubble, shall be placed in the trench in 152 mm layers and tamped in place. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that it retains alignment.

C. Pipe Preparation

1. Ream pipe and tube ends. Remove burrs.

2. Remove scale and dirt, on inside and outside, before assembly.

3. Prepare piping connection to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08305.

I. After pipe joints have "set" and test has indicated leakproof installation, any water in trench shall be removed and backfill shall be brought to required grade.

J. All water and sewer lines shall be installed below freeze line, with water piping buried a minimum of 24 inches.

K. Provide all sheathing and bracing, using the proper materials, where necessary for the work involved.

L. Maintain all excavations required herein free of standing water.

M. After all backfilling has been completed, remove all surplus excavation material from the Owner's property.

N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

O. Provide support for utility meters in accordance with requirements of utility companies.

P. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Section 09900.

Q. Excavate in accordance with Sections 02222 and 02225 for work of this Section.

R. Backfill in accordance with Sections 02223 and 02225 for work of this Section.

S. Install bell and spigot pipe with bell end upstream.

T. Install valves with stems upright or horizontal, not inverted.

U. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

3.4 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

C. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of [___] inch wg ([___] kPa). Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor drains.

B. Backflow preventers.

C. Cleanouts.

D. Hose bibs.

E. Hydrants.

F. Water hammer arrestors.

1.2 REFERENCES

A. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

B. ANSI A112.21.1 - Floor Drains.

C. ANSI A112.21.2 - Roof Drains.

D. ANSI A112.26.1 - Water Hammer Arrestors.

E. ASTM C478 - Precast Reinforced Concrete Manhole Sections.

F. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

G. PDI WH-201 Water Hammer Arresters.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Shop Drawings: Indicate dimensions, weights, and placement

of openings and holes.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of equipment, cleanouts, backflow preventers, etc.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Accept specialties on site in original factory packaging. Inspect for damage.

1.7 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide two sets of loose keys and service kit for backflow preventers

PART 2 PRODUCTS

2.1 MANUFACTURERS

Modular Design System

A. Acceptable Manufacturers:

1. Wade

a) Josam
b) J. R. Smith
c) Zurn

2.2 FLOOR DRAINS

A. FD-1: ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Drain body shall be adjustable for differing slab thickness.

B. FD-2: Same as FD-1 except without trap.

C. FD-3: Same as FD-1 except with polished bronze.

2.3 CLEANOUTS

A. Exterior Surfaced Areas (CO-1): [Round] [Square] cast nickel bronze access frame and non-skid cover.

B. Exterior Unsurfaced Areas (CO-2): Line type with lacquered cast iron body and round epoxy coated gasketed cover.

C. Interior Finished Floor Areas (CO-3): [Lacquered] [Galvanized] cast iron, two piece body with flange, round with scoriated cover in service areas and [round] [square] with depressed cover to accept floor finish in finished floor areas.

D. Interior Finished Wall Areas (CO-4): Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

E. Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.4 HOSE BIBS (HB-1)

A. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in conformance with ANSI/ASSE 1011.

2.5 HYDRANTS (HB-2)

A. Non-Freeze Wall Hydrant:
   1. Acceptable Manufacturers
      a. Wade
      b. Josam
      c. Woodford
      d. Zurn

B. Non-Freeze Wall Hydrant: ANSI/ASSE 1019; non-freeze, self-draining type with polished bronze lockable recessed box hose thread spout, handwheel, and integral vacuum breaker.

2.6 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors
   Acceptable Manufacturers
   a. Wade - Size to suit condition.
   b. Josam - Size to suit condition
   c. Zurn - Model 2-1310

B. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged suitable for operation in temperature range -73 to 149 degrees C and maximum 1700 kPa working pressure.

2.7 BACKFLOW PREVENTERS

A. Reduced pressure principle type. Furnish proof that each make, model/design, and size of backflow preventer being furnished for the project is approved by and has a current "Certificate of Approval" from the local code. Listing of the particular make, model/design, and size in the current local code will be acceptable. Backflow preventers shall be tested by a locally approved and certified backflow assembly

tester. A copy of the test report shall be provided.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate cutting and forming of floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Pipe relief from back flow preventer to nearest drain.

E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, and showers.

F. Install backflow preventers in accordance with the University of Southern California Manual of Cross-Connection Control, Ninth Edition. Test cocks shall be installed facing away from the mounting wall.

END OF SECTION

SECTION 15440

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Service sinks.

F. Electric water coolers.

G. Drinking fountains.

H. Showers.

I. Wash fountains.

J. Eyewash fountains.

K. Emergency showers.

1.2 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.

D. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.

E. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.

F. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).

G. IAPMO/ANSI Z124.1 - Plastic Bathtub Units.

H. IAPMO/ANSI Z124.2 - Plastic Shower Receptors and Shower Stalls.

I. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.

J. ANSI/ARI 1010 - Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and

prevent use.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings and instructed by the manufacturer.

B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

PART 2 PRODUCTS

2.1 Water Closet (WC-1)

A. Acceptable Manufacturers
   1. Water Closet and Seat

      a. American Standard
      b. Eljer
      c. Crane
      d. Kohler

B. ANSI/ASME A112.19.2; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 38 mm top spud, stainless steel china bolt caps.

C. Flush Valve

   1. Acceptable Manufacturers

      a. Sloan
      b. Zurn
      c. Delaney

   2. ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle located 600 mm above seat, escutcheon, seat bumper, integral screwdriver stop and vacuum breaker; maximum 6.0 liter flush volume.

D. Seat

1. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

E. Wall Mounted Carrier

1. Acceptable Manufacturers
   a. Wade Division/Tyler Pipe
   b. Josam Manufacturing Co.
   c. Jay R. Smith Mfg Co.
   d. Zurn Industries, Inc.

2. ANSI/ASME A112.6.1; adjustable non-adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.2 WATER CLOSET (WC-2)

A. Same as WC-1 except install per handicapped requirements.

2.3 URINAL (UR-1)

A. Urinal

1. Acceptable Manufacturers

   a. American Standard
   b. Kohler Co.

2. ANSI/ASME A112.19.2; vitreous china, wall hung siphon jet urinal with shields, integral trap, 20 mm top spud, steel supporting hanger.

B. Flush Valve

1. Acceptable Manufacturers:

   a) Sloan
   b) Zurn
   c) Delaney

2. ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, escutcheon, integral screwdriver stop, vacuum breaker; maximum (3.8 L) flush volume.

2.4 LAVATORY

A. Acceptable Manufacturers
Lavatory
a. American Standard
b. Eljer
c. Crane
d. Kohler

Faucet and Brass

a. American Standard
b. Eljer
c. Crane
d. Kohler
e. McGuire
f. Engineered Brass Co.

B. LAV-1

1. ANSI/ASME A112.19.2; vitreous china under counter lavatory, bone color, (refer to plans for size) with drillings on 100 mm centers, front overflow, seal of putty, caulking, or concealed vinyl gasket.

C. Trim

1. ASME A112.18.1; chrome plated supply fitting with open grid strainer, water economy aerator with max flow of 0.03 lps @ 400 kPa supply pressure, single lever handle, (min 100 mm long handle) chrome plated 1.3 mm brass P-trap with clean-out plug and arm with escutcheon.

2. Provide offset P-trap and supply/waste insulation kit for accessible lavatories.

D. LAV-2

Modular Design System

1. Same as L-1 except install per handicapped requirements.

E. WF-1 WASH FOUNTAIN:

1. ACCEPTABLE MANUFACTURERS

a. Bradley Corporation
b. Acorn Manufacturing

2. Faucet, Mixing Valve

a. Bradley Corporation
b. Acorn Manufacturing

3. Complete unit to include 4 person stainless steel bowl, circumferential foot treddle, thermostatic pressure balancing mixing valve for hot and cold water, check valves, stop valves, nozzle and flow control of 0.03 lps at 400 kPa at nozzle.

2.5 SINK

A. Acceptable Manufacturers

1. Just
2. Elkay

Faucet and Brass
Manufacturer

a. Just
b. Elkay
c. McGuire
d. Engineered Brass Co.

B. S-2 SCULLERY SINK

1. Stainless steel with dual 610 mm drainboards, two 760 mm by 610 mm compartments, 510 mm deep, 381.0 mm splashback.

2. Faucet and Spout: Cast or wrought copper alloy, with

backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Faucet flow shall not exceed 0.14 lps at 400 kPa.

3. Handles: Cast copper alloy, wrough copper alloy, or stainless steel. Four arm type.

4. Drain Assembly: Plug, cap strainer, crossbars, jam nuts, washers, couplings, stopper, etc. shall be copper alloy or stainless steel.

C. S-1

1. ANSI/ASME A112.19.3; double compartment 560 mm X 840 mm, 200 mm deep, 0.9 thick, Type 304 stainless steel, self-rimming with undercoating, 90 mm crumb cups, and stainless steel drain, ledge back drilled for trim.

D. Trim

1 ASME A112.18.1; chrome plated brass supply with swing spout, water economy with max flow of 0.14 lps @ 400 kPa aerator, single lever handle and retractable spray; chrome plated 1.3 mm brass P-trap with clean-out plug and arm with escutcheon.

2.6 SH-1 SHOWER

A. Trim

1. ASME A112.18.1; concealed shower supply with pressure balanced thermostatic mixing valves, bent shower arm with flow control and adjustable spray ball joint shower head and escutcheon.

B. Shower Head

1. ASME A112.18.1; chrome plated vandal-proof institutional head with integral wall bracket, built-in 0.16 L/sec flow control at 400 kPa.

2.7 SH-2 ACCESSIBLE SHOWER

A. Same as SH-1 except for the following:

B. Hand-Held Shower Head: Adjustable spray hand-held shower head with swivel fitting, pushbutton flow control, 60-inch minimum flexible chrome plated copper alloy hose and in-line vacuum breaker wall bracket to mount hand spray 25-inch grab bar with sliding spray holder that locks at any height to allow the use of the unit as either a hand-held spray or a fixed shower head.
   1. Symmons Industries, Model Hydrapipe 64 Series
   2. Leonard Valve Co., Model Surfashower Series
   3. Bradley Corp., Model Bradsole Series

2.8 EWC-1 ELECTRIC WATER COOLER

A. Fountain

   1. Acceptable Manufacturers:

      a) Haws — Model HWCF8-2RF or approved equal

   2. ANSI/ARI 1010; semi-recessed handicapped mounted electric water cooler with stainless dual stainless steel bowls stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push actuation control, mounting bracket, refrigerated with integral air cooled condenser.

      a) Capacity: 0.5 L/s of 10 degree C water with inlet at 27 degree C and room temperature of 32 degree C.

      b) Electrical: Maximum 0.15 kw, 6 FLA compressor, 2 m cord and plug for connection to electric wiring system including grounding connector.

2.9 MOP BASIN SERVICE SINK MB-1

A. Bowl

Modular Design System

1. Acceptable Manufacturers:

   a. Fiat Products
   b. Stern/Williams

2. ANSI/ASME A112.19.1; 560 x 460 x 300 mm deep, Terrazzo chrome plated strainer.

B. Trim

1. Acceptable Manufacturers:

   a. American Standard
   b. Eljer
   c. Crane
   d. Kohler

2. ASME A112.18.1 exposed wall type supply with lever handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges; 1.5 m of 13 mm diameter plain end reinforced rubber hose, hose clamp, mop hanger.

C. Accessories

1. Stainless steel wall splash guard.

2.10 EMERGENCY SHOWER (EWSH-1)

A. Acceptable Manufacturers:

   a. Haws
   b. Western
   c. Bradley

B. ANSI Z358.1; free standing, self- cleaning, non-clogging 200 mm diameter plastic deluge shower head with elbow, 25 mm full flow valve with pull rod and handle, 30 mm interconnecting fittings, 120 volt emergency light and horn; (activated on flow), ANSI Z358.1; self- cleaning, non-clogging eye and face

wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray ring, stainless steel dust cover, copper alloy control valve and fittings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install each fixture with trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid or flexible supplies to fixtures with wheel stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07900.

G. Solidly attach water closets to floor mounted carrier.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

A. Adjust work under provisions of Section 01700.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Clean work under provisions of 15010.

B. At completion clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01500 and 15010.

B. Do not permit use of fixtures.

3.8 FIXTURE HEIGHTS

A. Install fixtures to heights above finished floor as indicated.

B. Water-Closet

1. Standard 380 mm to top of bowl rim.
2. Handicapped per ADA requirements.

C. Urinal

1. Standard 560 mm to top of bowl rim.
2. Handicapped per ADA requirements.

D. Lavatory

Modular Design System

1. Standard 785 mm to top of basin rim.
2. Handicapped per ADA requirements.

E. Drinking Fountain

1. Standard 1015 mm to top of basin rim.
2. Handicapped per ADA requirements.

F. Water Closet Flush Valves

1. Standard 600 mm min. above bowl rim.

G. Shower Heads

1. Per ADA requirements.

H. Emergency Eye And Face Wash

1. Standard 965 mm to receptor rim.

I. Emergency Shower

1. Standard 2130 mm to bottom of head.

3.9 FIXTURE ROUGH-IN SCHEDULE

A. Fixture rough-in shall be as indicated on drawings.

END OF SECTION

SECTION 15450

PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged water heating systems

B. Wash water reclaim unit

C. Water storage tanks

D. Pumps.

1.2 REFERENCES

A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

B. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

C. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.

D. ANSI/NFPA 54 - National Fuel Gas Code.

E. ANSI/NFPA 58 - Storage and Handling of Liquified Petroleum Gases.

F. ANSI/NFPA 70 - National Electrical Code.

G. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.

H. ANSI/UL 174 - Household Electric Storage Tank Water Heaters.

I. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum).

J. ASTM A123 - 1978 zinc (Hot-Galvanized) Coatings on Products

K. ASTM C923 - 1989 Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes

L. ASTM D698 - 1978 Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb Rammer Aggregate Mixtures Using 5.5-lb Rammer and 12-inch Drop

M. ASTM D 2241 - 1980 Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)

N. ASTM D 2321 - 1974 (R80) Underground Installation of Flexible Thermoplastic Sewer Pipe

O. ASTM D 2466 - 1978 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

P. ASTM D 2487 - 1969 (R75) Classification of Soils for Engineering Purposes

Q. ASTM D 2564 - 1980 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

R. ASTM D 2774 - 1972 (R78) Underground Installation of Thermoplastic Pressure Piping

S. ASTM D 2855 - 1981 Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

T. AWWA-C600 - 1982 Installation of Ductile-Iron Water Mains and Their Appurtenances

U. MSS SP 80 - 1974 Bronze Gate, Globe, Angle, and Check Valves

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Shop Drawings:
   1. Include heat exchanger dimensions. size of tappings, and performance data.
   2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

Modular Design System

B. Product Data:
   1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements, and affected adjacent construction.
   3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   4. Provide electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State and Local Codes.

B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
   1. American Gas Association (AGA).
   2. National Sanitation Foundation (NSF).
   3. American Society of Mechanical Engineers (ASME).
   4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
   5. National Electrical Manufacturers' Association (NEMA).
   6. Underwriters Laboratories (UL).

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 REGULATORY REQUIREMENTS

A. Conform to NBBPVI requirements for water heaters.

B. Conform to ASME Section VIIID for tanks.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

Modular Design System

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.8 WARRANTY

A. Provide five year warranty under provisions of Section 15010.

B. Warranty: Include coverage of domestic water heaters, water storage tanks in-line circulator.

1.9 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

PART 2 PRODUCTS

2.1 PACKAGED WATER HEATING SYSTEM

A. Acceptable Manufacturers:

1. Raypak, Inc.
2. Weben-Jarco, Inc.
3. Patterson-Kelley Co.
4. Lochinvar, Inc.

B. Natural draft hot water heater with horizontal grid, finned tube heat exchanger, gas burning system, refractory combustion chamber, controls, and trim.

C. Electrical Characteristics:

1. Refer to Section 16180.

2.2 FABRICATION

A. Assembly: Finned copper tube heat exchanger assembled within combustion chamber conforming to ASME "H" requirements, and tested for maximum working pressure of 1100 kPa.

B. Combustion Chamber: Line with interlocking refractory insulating panels of vermiculite, high temperature cements,

asbestos fiber and refractory clay for service temperatures to 1150 degrees C.

C. Exchanger: Fabricate of finned copper tubing with stainless steel baffles and sealed into bronze, steel, or cast iron headers with silicone O-ring gaskets.

D. Jacket: Galvanized steel with factory applied baked enamel, insulated with foil faced fiberglass insulation.

2.3 FUEL BURNING SYSTEM

A. Atmospheric Gas Burner: Stainless steel burners for modulating firing natural gas with adjustable combustion air supply, gas pressure regulator, diaphragm gas valves, manual shut-off, intermittent spark or glow coil ignition, thermistor flame sensing device, and automatic 100% safety gas shut-off.

B. Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, allow gas valve to open, energize circulation pump.

C. Flue Gas Collector and Draft Hood: Integral with boiler casing with built-in induced draft fan, with draft gage and draft providing switches.

2.4 HOT WATER HEATER TRIM

A. ASME rated pressure relief valve set at 310 kPa.

B. Combination water pressure and temperature gage.

C. Low water cut-off and inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through burner section.

2.5 CONTROLS

A. Operating Controls: Pre-wired, factory assembled electric

control including pilot safety and thermocouple transformer, 24-volt gas valve, manual main and pilot valves, and junction box.

B. Operating temperature controller to control burner operation to maintain supply water temperature.

C. Dual, high limit temperature controller with one automatic and one manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.

2.6 CIRCULATION PUMP

A. Circulation pump shall be as specified in paragraph: In-Line Circulator Pumps.

2.7 STORAGE TANK

A. Storage tank shall be vertical configuration for storage capacity as indicated. Inner tank shall be jacketed with insulation housing to meet requirements of ASHRAE 90-1980.

B. Inner tank shall be constructed to ASME Standards for a working pressure of 1034 kPa. Tank shall be glass-lined and carry a five-year warranty.

C. Entire tank/jacket assembly shall be mounted on a sealed drain pan system with 20 mm drain connection.

2.8 IN-LINE CIRCULATOR PUMPS

A. Acceptable Manufacturers:

1. Grundfos
2. Armstrong

B. Casing: Bronze, rated for 860 kPa working pressure.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil

lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Drive: Flexible coupling.

2.9 SUBMERSIBLE SEWAGE GRINDER PUMP STATION

A. Acceptable Manufacturers

1. Gould

B. The sewage grinder pump station complete including, base plate, wet well, steel frame and cover, control equipment, pumps and piping, rails, chain, valves, and quick disconnect system shall be a package system provided by a single manufacturer regularly engaged in the production of complete package grinder pump stations.

C. Controls (Duplex): Float operated mechanical alternator with float rod, stops, and corrosion resistant float to alternate operation of pumps, cut-in second pump on rising level or lead pump failure, separate pressure switch high level alarm with transformer, alarm bell, and standpipe, and extra set of wired terminals for remote alarm circuit and emergency float switch with float rod, stops, and corrosion resistant float to operate both pumps on failure of alternator.

2.10 WASH WATER RECLAIM

A. Acceptable Manufacturers:

1. Landa
2. RGF

B. General

1. Wash water reclaim system shall process all effluent from the vehicle wash bay. System shall retain all impurities removed from water for zero discharge operation. System to include, but not be limited to the following:

Modular Design System

a) Effluent feed pump
b) Holding tank
c) Gravity separator
d) Coalescing oil/dirt/water separator
e) Oil skimmer
f) Ozone treatment for bacteria control
g) Absorption filtration process for degreaser removal.
h) Clean water storage tank with makeup water piping.
i) Transfer pump for delivery of processed water to pressure washer.
j) Impurity storage containers for holding all sediments, oils, etc.
k) Sump pump to transfer dirty water to reclaim unit for processing.

C. Performance

1. Solid particulate separation down to 20 micron particle size.

2. Free oil separation down to 1 micron particle size.

3. Capable of processing up to 30 gpm effluent. Feed pump shall cycle to accommodate reduced floe rates.

4. Automatically and continuously adjust clean water ph to levels acceptable for sanitary discharge.

5. Minimum 65 gallon clean water holding tank.

D. Operation

1. Wash effluent shall be collected in sump at the reclaim unit. A float operated sump pump shall transfer effluent to the holding tank.

2. Holding tank shall have high and low level float switches to operate filter pump as tank water level changes. Tank overflow shall be piped back to sump.

3. Filtration process shall be automatic when filter pump

runs.

4. Clean water shall be transferred back to pressure washer from clean water holding tank. A float switch shall disable transfer pump and open make-up water valve on low tank level. Clean water tank shall be provided with high level overflow to divert excessive water to sanitary sewer.

E. Assembly

1. Entire wash reclaim system shall be construction and shipped on a unitized steel base with side rails. Field assembly of components is not acceptable.

2. All interconnection piping between the various components of the assembly shall be in place when shipped. Piping connections shall include, but not be limited to:

   a) Effluent stream connection from sump.
   b) Effluent stream overflow back to sump.
   c) Make-up water connection.
   d) Reclaimed water connection.
   e) Storage tank overflow to sanitary sewer.

3. Entire assembly, except for non-ferrous components, shall be factory finished.

F. Electrical Controls

1. All aspects of system control shall be handled by an on board control system. Control signal voltage shall be 24 VDC. Provide control voltage transformer in control panel.

2. All electrical components shall be housed in a NEMA 4 enclosure.

3. Supply voltage shall be 460V, three phase.

PART 3 EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's written instructions and to ANSI/NFPA 54 requirements.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

3.2 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

3.3 WASH WATER RECLAIM UNIT INSTALLATION

A. Install reclaim system on concrete housekeeping pad, refer to Section 15010.

B. All field piping shall be installed according to the manufacturer's instructions. Slope overflow and drainage piping such that water is not held in piping.

C. Cross connection of reclaimed water and domestic water shall be provided by the installation of a reduced pressure principle backflow preventer. Pipe test ports through air gaps to sanitary sewer.

D. Provide startup assistance from manufacturer's representative for a period of 2 days. Perform system checkout, flow balance, and assist in final piping connections.

END OF SECTION

SECTION 15481

COMPRESSED AIR SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.

B. Reciprocating air compressor.

C. Air receiver and accessories.

D. Aftercooler.

E. Pressure reducing station.

F. Refrigerated air dryer.

G. Section 01010 - Summary of Work: Furnish and install a complete compressed air system.

1.2 REFERENCES

A. ASME - Boiler and Pressure Vessel Code.

B. ASME B16.3 - Malleable Iron Threaded Fittings.

C. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.

D. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

E. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.

F. ASME B31.1 - Power Piping.

G. ASME B31.9 - Building Services Piping.

H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated,

Welded and Seamless.

I. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

J. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

K. ASTM B32 - Solder Metal.

L. ASTM B88 - Seamless Copper Water Tube.

M. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.

N. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pipe.

O. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS: Submit under provisions of Section 01300 and 15010.

A. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.

B. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

C. Test Reports: Submit inspector's certificate for air receiver for inclusion in Operating and Maintenance Manuals.

D. Manufacturer's Installation Instructions: Indicate hoisting and setting requirements, starting procedures.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of equipment and components. Modify

shop drawings to indicate final locations.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Operation Data: Submit for air compressor, air receiver and accessories, after cooler, refrigerated air dryer, and pressure reducing station.

C. Maintenance Data: Submit for air compressor, air receiver and accessories, after cooler, refrigerated air dryer, and pressure reducing station.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable ASME code for installation of pressure vessels.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of air receiver.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Accept air compressors, refrigerated air dryer on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.

C. Protect piping and equipment from weather and construction traffic.

1.8 WARRANTY

A. Provide five year warranty under provisions of Section 01700 and 15010.

B. Warranty: Include coverage for reciprocating air compressors.

1.9 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of 01700 and 15010.

B. Provide two liter containers of compressor oil.

PART 2 PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.

2. Joints: Threaded or welded to ANSI B31.9.

B. Copper Tubing: ASTM B88, Type K hard drawn.

1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.

2. Joints: ASTM B32, solder, Grade 95TA.

2.2 BALL VALVES

A. Ball Valves
1. Acceptable Manufacturers:
a) Nibco
b) Hammond Valve Corp.

B. Up to and including 50 mm: Bronze two piece body, chrome plated steel ball, teflon seats and stuffing box ring, lever handle threaded ends with union.

C. Over 50 mm: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

A. Air Outlets

1. Quick Connector: Size as indicated, brass, snap on connector with self closing valve.

2. Serrated nozzle with male or female threads for hose to pipe connections.

2.3 UNIONS AND COUPLINGS

Modular Design System

A. Unions

1. Ferrous Pipe: 1 034 kPa malleable iron threaded unions.

2. Copper Tube and Pipe: 1 034 kPa bronze unions with soldered joints.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

C. Flexible Connector: Neoprene with brass threaded connectors.

2.4 COMPRESSOR

A. Acceptable Manufacturers:

1. Ingersoll-Rand

B. Type: Duplex compressor unit consisting of air cooled compressor, air receiver, after cooler, pressure regulating station, spring isolators, motor, and operating controls.

C. Compressor: Cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connecting rods, aluminum pistons with rings, high-strength alloy suction and discharge valves, pressurized lubrication system. Statically and dynamically balance rotating parts.

D. Motor: 460/3/60 voltage, open drip proof.

E. Oil Pressure Switch: Equip compressor to automatically shut down compressor in event of oil pressure failure.

F. Capacity Reduction: Suction valve unloader with lifting mechanism operated by oil pressure. Provide for unloaded compressor start.

G. Base: One piece ribbed cast iron or welded steel base for motor and compressor with provision for V-belt adjustment.

H. Automatic condensate drain.

I. Aftercooler Construction: Removable tube nests of non-ferrous metal tubes and corrosion resistant tube plates, safety valves, pressure gage, moisture separator, moisture drain valve, water inlet piping with automatic water valve, automatic condensate trap and overflow piping with open funnel.

J. Working Pressure: 931 kPa.

K. Discharge: Cool air to within 7 degrees C of ambient air temperature at specified flow capacity.

Modular Design System

L. Capacity: As indicated.

M. Moisture Separator: Centrifugal type located at discharge of heat exchanger.

N. Air Receiver:

1. Built to ASME regulations for working pressure of 862 kPa. Flange or screw inlet and outlet connections.

2. Fittings: Adjustable pressure regulator, safety valve, pressure gage, drain cock, and automatic float actuated condensate trap.

3. Tank Finish: Shop painted.

4. Capacity as indicated.

O. Pressure Reducing Station: Consisting of automatic reducing valve and bypass, and low pressure side relief valve and gage.

P. Valve Capacity: Reduce pressure from 1379 kPa to 207 kPa, adjustable upwards from reduced pressure.

2.5 REFRIGERATED COMPRESSED AIR DRYERS

A. Refrigerated compressed air dryers shall provide compressed air with a dewpoint of 4 deg. C. Unit shall include, but not be limited to, a precooler/reheater, automatic drain, constant pressure expansion valve, refrigerant analyzer gauge, thermal overload, refrigerant high and low pressure cutout, starter, compressor, liquid receiver, are cooled condenser and an air-to-refrigerant heat exchanger. Air dryer system shall also include a pre-filter/coalescer rated to remove oil to 1 micron and an after filter rated to remove particulate to 5 microns. Refrigerants shall have an ozone depletion factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal" Protocol on Substances That Deplete the Ozone Layer," September 1987, sponsored by the United National Environmental Programme. R-11, R-12, R-113,

R-114, R-115, or R-500 shall not be used.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install compressor unit on concrete housekeeping pad. Refer to Section 15010.

C. Install compressor unit on vibration isolators. Level and bolt in place. Refer to Section 15242.

D. Make air cock and drain connection on horizontal casing.

E. Install line size ball valve and check valve on compressor discharge.

F. Install replaceable cartridge type filter silencer of adequate capacity for each compressor.

G. Place shut off valve on water inlet to aftercooler. Pipe drain to floor drain.

H. Connect condensate drains to nearest floor drain from receiver and air dryer.

I. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.

J. Install valved drip connections at low points of piping system.

K. Install take offs to outlets from top of main, with shut off valve after take off. Slope take off piping to outlets.

L. Install compressed air couplings, female quick connectors, and pressure gages where outlets are indicated.

M. Install tees instead of elbows at changes in direction of

piping. Fit open end of each tee with plug.

N. Identify piping system and components. Refer to Section 15190.

3.2 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01400 and 15010.

B. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ANSI B31.1.

C. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.

D. Cap (seal) ends of piping when not connected to mechanical equipment.

END OF SECTION

SECTION 15510

HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings for:

1. Heating water piping system.
2. Chilled water piping system.
3. Equipment drains and overflows.

B. Valves:

1. Globe or angle valves.
2. Ball valves.
3. Check valves.
4. Balance valves.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Braising Operators.

B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

E. ASME B31.5 - Refrigeration Piping.

F. ASME B31.9 - Building Services Piping.

G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

H. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

I. ASTM B32 - Solder Metal.

J. ASTM B88 - Seamless Copper Water Tube.

K. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

L. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings.

M. ASTM D2241 - Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).

N. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.

O. ASTM D2466 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

P. ASTM D2467 - Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

Q. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite-Sewer Piping.

R. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

S. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

T. ASTM D2855 - Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

U. ASTM D3309 - Polybutylene (PB) Plastic Hot-and Cold-Water

Distribution Systems.

V. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

W. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

X. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Tubing.

Y. ASTM F876 - Crosslinked Polyethylene (PEX) Tubing.

Z. ASTM F877 - Crosslinked Polyethylene (PEX) Plastic Hot - and Cold - Water Distribution Systems.

AA. AWS A5.8 - Brazing Filler Metal.

AB. AWS D1.1 - Structural Welding Code.

AC. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

AD. AWWA C110 - Ductile - Iron and Grey -Iron Fittings 3 in. through 48 in., for Water and Other Liquids.

AE. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.

AF. AWWA C151 - Ductile-Iron Pipe,Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

AG. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

AH. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

AI. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

AJ. ASTM A 47 Specification for Ferritic Malleable Iron Castings

AK. ASTM A 126 Specification for Gray Iron Castings for Valves, Flanges, & Pipe Fittings

AL. ASTM A 536 Specification for Ductile Iron Castings

AM. ASTM D 2564 Specification for Solvent Cements for PVC Plastic Pipe & Fittings

AN. ASTM D2661 Specification For Acrylonitrile - Butadiene - Styrone (ABS) Schedule 40 Plastic Drain, Waste, & Vent Pipe & Fittings

AO. ASTM D 2672 Specification for Joints for IPS PVC Pipe Using Solvent Cement

AP. ASTM D 2846 Specification For CPVC Plastic Hot & Cold Water Distribution Systems

AQ. ASTM D 3138 Specification for Solvent Cements for Transition Joints Between ABS & PVC Non-Pressure Piping Components

AR. ASTM F 402 Practice For Safe Handling Of Solvent Cements, Primers, & Cleaners Used For Joining Thermoplastic Pipe & Fittings

AS. ASTM F 493 Specification For Solvent Cements For CPVC Plastic Pipe & Fittings

AT. ASME B1.20.1 Pipe Threads, General Purpose

AU. ASME B16.20 Ring - Joint Gaskets & Grooves For Steel Pipe Flanges

AV. ASME B16.21 Nonmetallic Flat Gaskets For Pipe Flanges

AW. ASME B18.2.1 Square & Hex Bolts & Screws

AX. AWS Soldering Manual & Brazing Manual

AY. AWS D10.12 Recommended Practices & Procedures For Welding Low Carbon Steel Pipe

Modular Design System

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

C. Use non-conducting dielectric connections whenever jointing dissimilar metals.

D. Provide pipe hangers and supports in accordance with MSS SP69 unless indicated otherwise.

E. Use gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Use globe valves for throttling, bypass, or manual flow control services.

G. Use 19 mm ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.4 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

B. Welders Certificate: Include welders certification of compliance with AWS D1.1.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of valves.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum 3 years documented experience.

C. Welders: Certify in accordance with AWS D1.1.

1.8 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide two repacking kits for each size and valve type.

PART 2 PRODUCTS

2.1 HYDRONIC (HEATING AND CHILLED) WATER PIPING

A. Steel Pipe: ASTM A53, Schedule 40, black.

1. Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.

2. Joints: Threaded, or AWS D1.1,welded.

B. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.

2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

3. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C. Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 - 805 degrees C.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.

2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C.

2.3 PIPE HANGERS AND SUPPORTS

A. Refer to Section 15140.

2.4 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 51 mm and Under:

1. Ferrous Piping: 1030 kPa malleable iron, threaded.

2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 51 mm:

1. Ferrous Piping: 1030 kPa forged steel, slip-on.

2. Copper Piping: Bronze.

3. Gaskets: 1.6 mm thick preformed neoprene.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 GATE VALVES

A. Valves Up To and Including 51 mm:

1. Acceptable Manufacturers:

Modular Design System

a) Grinnell Corp.
b) Nibco, Inc.
c) Milwaukee Valve Co.
d) Stockham, Valves and Fittings, Inc.

2. Bronze body, bronze trim, union bonnet, rising stem, handwheel, inside screw, solid wedge disc, alloy seat rings, threaded ends.

B. Valves Over 51 mm:

1. Acceptable Manufacturers:

a) Grinnell Corp.
b) Nibco, Inc.
c) Milwaukee Valve Co.
d) Stockham, Valves and Fittings, Inc.

2. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

2.6 GLOBE OR ANGLE VALVES

A. Valves Up To and Including 51 mm:

1. Acceptable Manufacturers:
a) Grinnell Corp.
b) Nibco, Inc.
c) Milwaukee Valve Co.

2. Bronze body, bronze trim, screwed bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, threaded ends.

B. Valves Over 51 mm:

1. Acceptable Manufacturers:

a) Grinnell Corp.
b) Nibco, Inc.

c) Milwaukee Valve Co.
d) Stockham, Valves and Fittings, Inc.

2. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.7 BALL VALVES

A. Valves Up To and Including 51 mm:

1. Acceptable Manufacturers:

a) Grinnell Corp.
b) Nibco, Inc.
c) Milwaukee Valve Co.
d) Stockham, Valves and Fittings, Inc.

2. Bronze two piece body, fullport chrome plated steel ball, teflon seats and stuffing box ring, lever handle with balancing stops for throttling services, threaded ends with union.

B. Valves Over 51 mm:

1. Acceptable Manufacturers:

a) Grinnell Corp.
b) Nibco, Inc.
c) Milwaukee Valve Co.
d) Stockham, Valves and Fittings, Inc.

2. Cast steel body, full port chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.8 BALANCING VALVES

A. Balancing valves shall be calibrated bronze body balancing valves with integral ball valve and venturi or valve orifice and valve body pressure taps for flow measurement based on

differential pressure readings. Valve pressure taps and meter connections shall have seals and built-in check valves with threaded connections for a portable meter. Meter shall be provided by the same manufacturer and be capable of reading system pressures. Valves shall have internal seals to prevent leakage around rotating element and be suitable for full shut-off rated pressure. Valves shall have an operator with integral pointer and memory stop. Balancing valves shall be selected for the required flows as indicated on the plans.

B. Portable Meter

1. Provide meter with a factory-fabricated carrying case with carrying handle. Provide case fitted to hold meter securely and to accommodate the following accessories:

2. Two 15 foot lengths of connecting hose with suitable female connectors for connecting from meter to orifice flange and balancing valve pressure-tap nipples. Provide hose designed for a minimum service pressure of 125 psi or 150 percent of maximum system service pressure, whichever is greater.

3. A completely assembled three-valve manifold with two block valves and vent and drain valves, piped and mounted on a base designed for use laying flat on a stationary surface.

4. A bound set for descriptive bulletins, installation and operating instructions, parts, list, and a set of curves showing flow versus pressure differential for each orifice, with which meter is to be used.

5. A metal instruction plate, secured inside cover, illustrating use of meter.

6. Provide meters with overall accuracy of plus or minus 5 percent of full scale flow over range from 20 to 100 percent of full scale flow.

2.9 SWING CHECK VALVES

A. Valves Up To and Including 51 mm:

1. Acceptable Manufacturers:

a) Grinnell Corp.
b) Nibco, Inc.
c) Mueller Steam Specialty Co.
d) Stockham, Valves and Fittings Inc.

2. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, [solder] [or] [threaded] ends.

B. Valves Over 51 mm:

1. Acceptable Manufacturers:

a) Grinnell Corp.
b) Nibco, Inc.
c) Mueller Steam Specialty Co.
d) Stockham, Valves and Fittings Inc.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Section 15545

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, chilled water, water, piping to ASME B31.9.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 15121.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 15260.

J. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08305.

K. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

M. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09900.

Modular Design System

N. Install valves with stems upright or horizontal, not inverted.

O. Set memory stops on balance after system testing and balancing.

3.3 SCHEDULES

A. Pipe Hanger Spacing.

PIPE SIZE mm	HANGER ROD MAX. HANGER SPACING m	HANGER ROD DIAMETER mm
13 to 32	2.0	10
38 to 51	3.0	9
64 to 76	3.0	13
102 to 152	3.0	16

END OF SECTION

SECTION 15515

HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Pump suction fittings.

F. Flow meters.

G. Relief valves.

H. Glycol solution.

1.2 CODES AND STANDARDS (Latest Edition or Revision)

A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

B. ANSI B1.20.1 - Pipe Threads

C. ANSI 16.1 - Cast-Iron Pipe Flanges & Flanged Fittings, Class 25, 125, 250, and 800

D. ANSI B16.3 - Malleable-Iron Threaded Fittings, Class 150 and 300.

E. ANSI B16.4 - Cast-Iron Threaded Fittings, Class 125 and 250.

F. ANSI B16.5 - Pipe Flanges & Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

G. ANSI B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

H. ANSI B16.24 - Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300.

I. ASTM A53 - Specification For Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless

J. ASTM B32 - Specification For Solder Metal

K. ASTM B88 - Specification For Seamless Copper Water Tube

L. ASTM A47 - Specification For Ferritic Malleable Iron Castings

M. ASTM A126 - Specification For Gray Iron Castings For Valves, Flanges, & Pipe Fittings

N. ASTM A536 - Specification For Ductile Iron Castings

O. AWS Soldering Manual and Brazing Manual

P. AWS A5.8 - Specification For Filler Metals For Brazing

Q. AWS D1.1 - Structural Welding Code For Steel

R. AWS D10.12 - Recommended Practices & Procedures For Welding Low Carbon Steel Pipe

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

B. Inspection Certificate: Submit inspection certificates for pressure vessels from authority having jurisdiction.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of flow meters.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of glycol system for one year

from date of substantial completion.

B. Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

1.9 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide one extra 38 L drum of ethylene glycol.

PART 2 PRODUCTS

2.1 DIAPHRAGM-TYPE EXPANSION TANKS

A. Acceptable Manufacturers:

a) Armstrong Pumps, Inc.
b) Bell & Gossett Corp.
c) Taco, Inc.

B. Construction: Welded steel, tested and stamped in accordance with ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 860 kPa, with flexible butyl diaphragm sealed into tank, and steel support rack.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 80 kPa.

2.2 AIR VENTS

A. Manual Air Vent: Short vertical sections of 51 mm diameter pipe to form air chamber, with 3 mm brass needle valve at top of chamber.

B. Automatic Float Type Air Vent:

Modular Design System

1. Acceptable Manufacturers:

   a) Armstrong Pumps, Inc.
   b) Bell & Gossett Corp.
   c) Taco, Inc.

2. Vents shall have brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type Air Vent.

1. Acceptable Manufacturers:

   a) Armstrong Pumps, Inc.
   b) Bell & Gossett Corp.
   c) Taco, Inc.

2. Vents shall have brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.3 AIR SEPARATORS

A. In-line Air Separator:

1. Acceptable Manufacturers:

   a) ITT Bell & Gossett Corporation
   b) Taco, Inc.
   c) Armstrong Pumps, Inc.

2. Air separators shall be cast iron for sizes 38 mm and smaller, or steel for sizes 51 mm and larger; tested and stamped in accordance with ASME SEC 8-D; for 860 kPa operating pressure.

2.4 STRAINERS

A. Size 51 mm and Under:

Modular Design System

1. Acceptable Manufacturers:

   a) Grinnell Corp.
   b) Metraflex Co.
   c) Armstrong, International, Inc.

2. Strainers shall have screwed brass or iron body for 1200 kPa working pressure, Y pattern with 0.8 mm stainless steel perforated screen.

B. Size 64 mm to 102 mm:

1. Acceptable Manufacturers:

   a) Grinnell Corp.
   b) Metraflex Co.
   c) Armstrong, International, Inc.

2. Strainers shall have flanged iron body for 1200 kPa working pressure, Y pattern with 1.2 mm stainless steel perforated screen.

2.5 PUMP SUCTION FITTINGS

A. Acceptable Manufacturers:

1. Armstrong Pumps, Inc.
2. Bell & Gossett Corp.
3. Taco, Inc.

B. Fittings shall have angle pattern, cast-iron body, threaded for 51 mm and smaller, flanged for 64 mm and larger, rated for 1210 kPa working pressure, with inlet vanes, cylinder strainer with 5 mm diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

2.6 COMBINATION PUMP DISCHARGE VALVES

Modular Design System

A. Acceptable Manufacturers:

1. Armstrong Pumps, Inc.
2. Bell & Gossett Corp.
3. Taco, Inc.

B. Valves shall have straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 1210 kPa operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.7 FLOW METERS

A. Acceptable Manufacturers:

1. Armstrong Pumps, Inc.
2. Metraflex Co.
3. Honeywell, Inc.

B. Meters shall be cast iron, wafer type, orifice insert flow meter for 1720 kPa working pressure, with read-out valves equipped with integral check valves with gasketed caps.

C. Portable meters shall consist of case containing one, 3 percent accuracy pressure gage with 0-180 kPa pressure range for 3450 kPa maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.8 RELIEF VALVES

A. Acceptable Manufacturers:

1. Armstrong Pumps, Inc.
2. Amtrol, Inc.
3. ITT Mcdonnell & Miller

B. Valves shall have bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.9 GLYCOL SYSTEMS

A. Mixing Tank: 208 L steel drum with fittings suitable for filling and hand pump for charging, rubber hose for connection of hand pump to system.

B. Glycol Solution:
   1. Inhibited ethylene glycol and water solution mixed 30 percent glycol - 70 percent water, suitable for operating temperatures from -40 degrees C to 121 degrees C.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain and hose connection on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps. Individual shutoff, check and balance valves may be provided in lieu of combination valve.

Modular Design System

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide relief valves on pressure tanks, low pressure side of reducing valves, and expansion tanks.

K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

L. Pipe relief valve outlet to nearest floor drain.

M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

N. Clean and flush glycol system before adding glycol solution. Refer to Section 15545.

O. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

P. Perform tests determining strength of glycol and water solution and submit written test results.

END OF SECTION

SECTION 15540

HVAC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. In-line circulators.

B. Vertical in-line pumps.

C. Base mounted pumps.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. UL 778 - Motor Operated Water Pumps.

B. NFPA 70 - National Electrical Code.

C. ASME B16.1 - Cast-Iron Pipe Flanges & Flanged Fittings, Class 25, 125, 250 and 800.

D. ASTM A36 - Specification For Structural Steel.

E. ASTM B36 - Specification For Brass Plate, Sheet, Strip, and Rolled Bar.

F. ASTM B584 - Specification For Copper Alloy Sand Castings For General Applications.

1.3 PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS: Submit under provisions of Section 15010.

Modular Design System

A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

B. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

C. Millwright's Certificate: Certify that base mounted pumps have been aligned.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years experience.

B. Alignment: Base mounted pumps shall be aligned by qualified millwright.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide one set of mechanical seals for each pump.

PART 2 PRODUCTS

2.1 IN-LINE CIRCULATORS

A. Acceptable Manufacturers:

1. Armstrong Pump Inc.
2. ITT Bell & Gossett
3. Paco Pumps, Inc.
4. Amtrol, Inc.
5. Weinman Pumps
6. Aurora Pump

B. Type: Pump shall have horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 860 kPa maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Stamped brass or cast bronze, keyed to shaft.

E. Bearings: Two, oil lubricated bronze sleeves.

F. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.

G. Seal: Carbon rotating against a stationary ceramic seat, 100 degrees C maximum continuous operating temperature.

H. Drive: Flexible coupling.

I. Electrical Characteristics:

1. Refer to Section 16180.

2. Motor: 1750 rpm unless indicated otherwise; refer to Section 15170.

3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.2 BASE MOUNTED PUMPS

A. Acceptable Manufacturers:

1. Armstrong Pump Inc.
2. ITT Bell & Gossett
3. Paco Pumps, Inc.
4. Amtrol, Inc.
5. Weinman Pumps
6. Aurora Pump

B. Type: Pump shall have horizontal shaft, single stage, radially split casing, for 1720 kPa maximum working pressure.

C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

D. Impeller: Bronze, fully enclosed, keyed to shaft.

E. Bearings: Grease lubricated roller or ball bearings.

F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

G. Seal: Carbon rotating against a stationary ceramic seat, 100 degrees C maximum continuous operating temperature.

H. Drive: Flexible coupling with coupling guard. Close coupled pumps are not acceptable.

I. Baseplate: Cast iron or fabricated steel with integral drain rim.

J. Electrical Characteristics:

1. Refer to Section 16180.
2. Motor: 1750 rpm unless specified otherwise; refer to Section 15170.
3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials

indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3. EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 102 mm and over. Refer to Section 15245.

D. Provide line sized shut-off valve and strainer or pump suction fitting on pump suction, and line sized soft seat check valve and balancing valve or combination pump discharge valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Check, align, and certify alignment of base mounted pumps prior to start-up.

H. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.

I. Lubricate pumps before start-up.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 15545

CHEMICAL WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

B. Chemical feeder equipment.

C. Chemical treatment.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

D. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

E. Certificate: Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer: Company specializing in performing the work of this section with minimum 3 years experience and approved by manufacturer.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for public sewage systems.

B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.8 MAINTENANCE SERVICE

Modular Design System

A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.

B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

C. Provide laboratory and technical assistance services during this maintenance period.

D. Include two hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.9 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of 01700.

B. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

A. System Cleaner:

1. Acceptable Manufacturers:

a) Anderson Chemical Co.
b) Aqua-Flo, Inc.
c) Nalco Chemical Co.

Modular Design System

2. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.

3. Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

B. Closed System Treatment (Water):

1. Acceptable Manufacturers:

a) Anderson Chemical Co.
b) Aqua-Flo, Inc.
c) Nalco Chemical Co.

2. Sequestering agent to reduce deposits and adjust pH [; polyphosphate.

3. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.

4. Conductivity enhancers; phosphates or phosphonates.

2.2 BY-PASS (POT) FEEDER

A. Acceptable Manufacturers:

1. Anderson Chemical Co.
2. Aqua-Flo, Inc.
3. Nalco Chemical Co.

B. Feeder shall be 22.7 L quick opening cap for working pressure of 1210 kPa.

2.3 WATER METER

A. Acceptable Manufacturers:

Modular Design System

1. Honeywell, Inc.
2. Armstrong Pumps, Inc.

B. Meter shall be displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register.

C. Pipe make up water to all closed systems through common water meter.

2.4 WATER SOFTENERS

A. Manufacturers:

1. Bruner Corp.
2. Water Management Services, Inc.
3. Cleaver-Brooks

B. Rated Performance:

1. Softening Capacity: 45,000 grains
2. Service Flow: 0.95 L/s.
3. Electrical Characteristics: 120 volts, single phase, 60 Hz.

C. Softener Tank: Glass fiber reinforced plastic tank, resin capacity 42 L.

D. Brine Tank: Glass fiber reinforced plastic tank, salt capacity 10.5 kg.

E. Control: Brass reinforced plastic control valve cycled to regenerate after adjustable metered quantity of water flow.

2.5 TEST EQUIPMENT

A. Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4 - 10 ml zeroing titrating burettes and associated reagents.

B. Provide the following test kits:

Modular Design System

1. Alkalinity titration test kit.
2. Chloride titration test kit.
3. Sulphite titration test kit.
4. Total hardness titration test kit.
5. Low phosphate test kit.
6. Conductivity bridge, range 0 - 10,000 microhms.
7. Creosol red pH slide complete with reagent.
8. Portable electronic conductivity meter.
9. High nitrite test kit.

PART 3 EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

A. Concentration:

1. As recommended by manufacturer.

2. 1 kg per 1000 L of water contained in the system.

3. 1 kg per 1000 L of water for hot systems and 1 kg per 500 L of water for cold systems.

B. Hot Water Heating Systems:

1. Apply heat while circulating, slowly raising temperature to 71 degrees C and maintain for 12 hours minimum.
2. Remove heat and circulate to 37.8 degrees C or less; drain systems as quickly as possible and refill with

clean water.

3. Circulate for 6 hours at design temperatures, then drain.

4. Refill with clean water and repeat until system cleaner is removed.

C. Chilled Water Systems:

1. Circulate for 48 hours, then drain systems as quickly as possible.

2. Refill with clean water, circulate for 24 hours, then drain.

3. Refill with clean water and repeat until system cleaner is removed.

D. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect/Engineer.

E. Flush glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.

F. Remove, clean, and replace strainer screens.

G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

Modular Design System

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide 19 mm water coupon rack around circulating pumps with space for 12 test specimens.

END OF SECTION

SECTION 15558

FINNED WATER TUBE BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Controls and boiler trim.

C. Hot water connections.

D. Fuel connection.

E. Collector, draft hood, and chimney connection.

F. Collector, induced draft fan, and chimney connection.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. AGA - Directory of Certified Appliances and Accessories.

B. AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.

D. ASME SEC 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

E. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. NFPA 54 (AGA Z223.1) - National Fuel Gas Code.

H. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.

I. NFPA 70 - National Electrical Code.

J. UL - Gas and Oil Equipment Directory.

1.3 SUBMITTALS: Section 15010 - Submittals: Procedures for submittals.

A. Product Data: Provide data indicating general assembly, rated capacities, weights (shipping, installed, and operating), components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements.

B. Shop Drawings: Submit shop drawings, detailing fabrication and installation of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

C. Installation Instructions: Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

D. Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

E. Factory Test Reports: Submit reports indicating and interpreting test results relative to compliance with specified requirements, for information.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

G. Wiring Diagrams: Submit wiring diagrams detailing power

and control wiring and differentiating clearly between manufacturer - installed wiring and field-installed wiring.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm whose boilers are listed by product name and manufacturer in The Hydronics Institute's "I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) Radiation" and comply with requirements indicated.

B. Comply with NFPA 70 "National Electrical code" for components and installation.

C. Listing and Labeling:

1. Provide products specified in this Section that are listed and labeled.

2. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code, "Article 100.

3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. ASHRAE Compliance: Minimum steady state efficiency of boilers as prescribed by ASHRAE 90.1 "Energy Efficient Design of New Buildings Except "Low-Rise Residential Buildings."

E. ASME Compliance: Fabricate and stamp boilers according to ASME Boiler and Pressure Vessel code, Section IV, "Heating Boilers."

F. I=B=R Compliance: Boilers tested and rated according to The Hydronics Institute's "Testing and Rating Standard for Heating Boilers," with I=B=R emblem on a nameplate affixed to the boiler.

G. FM Compliance: Control devices and control sequences according to requirements of Factory Mutual System (FM).

H. IRI Compliance: Control devices and control sequences according to requirements of Industrial Risk Insurers (IRI).

I. Coordination: Coordinate layout and installation of boilers with related work.
   1. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer.

   2. Coordinate size and location of concrete housekeeping pads.

1.6 REGULATORY REQUIREMENTS

A. Conform to NFPA 70 for internal wiring of factory wired equipment.

B. Conform to ASME SEC 4 and SEC 8D and AGA Z21.13 for boiler construction.

C. Units: UL labeled.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Section 15010 - Material and Equipment: Transport, handle, store, and protect products.

B. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

C. Deliver boilers in sufficient time to allow movement into building.

1.8 WARRANTY

A. Provide a five year warranty to include coverage for heat exchangers.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. Acceptable Manufacturers:

1. Raypak, Inc.
2. Weben-Jarco, Inc.
3. Patterson-Kelley Co.
4. Lochinvar, Inc.

B. Hot water boiler with horizontal grid, finned tube heat exchanger, gas burning system, refractory combustion chamber, controls, and boiler trim.

C. Electrical Characteristics:

1. Refer to Section 16180.

2.2 FABRICATION

A. Assembly: Finned copper tube heat exchanger assembled within combustion chamber conforming to ASME SEC 4 and SEC 8D requirements, and tested for maximum working pressure of 1100 kPa.

B. Combustion Chamber: Line with interlocking refractory insulating panels of vermiculite, high temperature cements,

asbestos fiber and refractory clay for service temperatures to 1150 degrees C.

C. Exchanger: Fabricate of finned copper tubing with stainless steel baffles and sealed into bronze, steel, or cast iron headers with silicone O-ring gaskets.

D. Jacket: Galvanized steel with factory applied baked enamel, insulated with foil faced fiberglass insulation.

2.3 FUEL BURNING SYSTEM

A. Induced Draft Gas Burner: Stainless steel burners for modulating firing of natural gas with adjustable combustion air supply, gas pressure regulator, diaphragm gas valves, manual shut-off, intermittent spark or glow coil ignition, thermistor flame sensing device, and automatic 100% safety gas shut-off.

B. Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven allow gas valve to open.

C. Flue Gas Collector and Draft Hood: Integral with boiler casing with built-in induced draft fan, with draft gage and draft providing switches.

2.4 HOT WATER BOILER TRIM

A. ASME rated pressure relief valve set at 310 kPa.

B. Combination water pressure and temperature gage.

C. Low water cut-off and inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through boiler.

2.5 CONTROLS

Modular Design System

A. Operating Controls: Pre-wired, factory assembled electric control including pilot safety and thermocouple transformer, 24-volt gas valve, manual main and pilot valves, and junction box.

B. Operating temperature controller to control burner operation to maintain supply water temperature.

C. Unit shall be connected ot the facility DDC control system. All control parameters and alarms shall be accessible through the DDC connection, and at a future date, to the basewide EMCS.

D. High limit temperature controller with automatic reset for burner to prevent boiler water temperature from exceeding safe system temperature.

2.6 PERFORMANCE

A. Performance rating shall be in accordance with HI - Testing and Rating Standard for Cast Iron and Steel Heating Boilers. Indicated performance is net I=B=R. Include boiler efficiency when selecting input KW rating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine area to receive boiler for compliance with installation tolerances and other conditions affecting boiler performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boilers level and plumb, according to manufacturer's written instructions, rough-in drawings, and referenced standards.

C. Install in accordance with NFPA 54.

D. Install boiler on a housekeeping pad.

E. Provide connection of natural gas service in accordance with NFPA 54.

F. Provide piping connections and accessories as indicated; refer to Section 15515.

G. Pipe relief valves to exterior of building.

H. Install electrical devices furnished with boiler, but not specified to be factory mounted.

I. Provide for connection to electrical service. Refer to Section 16180.

3.3 CONNECTIONS

A. Install piping adjacent to boiler to allow service and maintenance.

B. Connect gas piping to boiler to full size of boiler gas train inlet. Provide union with sufficient clearance for burner removal and service.

C. Connect hot water piping to supply and return boiler tappings. Provide shutoff valve and union or flange at each connection.

D. Connect breeching to boiler outlet, full size of outlet.

3.4 FIELD QUALITY CONTROL

A. Hydrostatically test assembled boiler and piping, according to applicable sections of ASME Boiler and Pressure Vessel Code.

3.5 ADJUSTING AND CLEANING

Modular Design System

A. Flush and clean boilers upon completion of installation, according to manufacturer's instructions.

B. Clean factory-finished surfaces, and repair any marred or scratched surfaces with manufacturer's touchup paint.

3.6 COMMISSIONING

A. Provide services of a factory-authorized service representative to provide startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements of Division 16 Sections. Do not proceed with boiler startup until wiring installation is acceptable to equipment installer.

C. Start boilers according to manufacturer's instructions.

D. Adjust burner for maximum burning efficiency.

E. Operate and adjust controls and safeties.

3.7 DEMONSTRATION

A. Provide services of a factory-authorized service representative to demonstrate boiler and train Owner's maintenance personnel.

B. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.

C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

D. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

E. Schedule training with Owner with at least 7 days' advance

notice.

3.8 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 15951.

B. Instruct operating personnel in operation and maintenance of units.

END OF SECTION

SECTION 15575

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated breechings.

B. Manufactured chimneys for gas fired equipment.

C. Vent dampers.

D. Manufactured double wall chimneys for fuel fired equipment.

E. Induced draft fans.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ANSI Z21.66 - Electrically Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.

B. ANSI Z21.67 - Mechanically Actuated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.

C. ANSI Z21.68 - Thermally Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.

D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

E. ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.

F. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.

G. ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent) Hot-Rolled Commercial Quality.

H. ASTM C64 - Refractories for Incinerators and Boilers.

I. ASTM C105 - Ground Fire Clay as a Refractory Mortar for Laying-up Fireclay Brick.

J. ASTM C401 - Classification of Castable Refractories.

K. NEMA MG1 - Motors and Generators.

L. NFPA 31 (ANSI Z95.1) - Standard for the Installation of Oil Burning Equipment.

M. NFPA 54 (ANSI Z223.1) - The National Fuel Gas Code.

N. NFPA 70 - National Electrical Code.

O. NFPA 82 - Standard on Incinerators, Waste, and Linen Handling Systems and Equipment.

P. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

R. UL 103 - Standard for Factory Built Low Heat Chimneys.

S. UL 127 - Standard for Factory Built Fireplaces.

T. UL 378 - Standard for Draft Equipment.

U. UL 441 - Standard for Gas Vents.

V. UL 641 - Standard for Low Temperature Venting Systems.

W. UL 959 (ANSI Z181.1) - Medium Heat Appliance Factory Built Chimneys.

X. AWS D91. - Specifications For Welding Sheet Metal.

1.3 DEFINITIONS

Modular Design System

A. Breeching: Vent Connector.

B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C. Smoke Pipe: Round, single wall vent connector.

D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.4 DESIGN REQUIREMENTS

A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

1.5 SUBMITTALS: Section 15010 - Submittals: Procedures for submittals.

A. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.

B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

C. Installation Instructions: Submit manufacturer's installation instructions: Indicate assembly, support details, and connection requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in

manufacturing the Products specified in this section with minimum three years experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

C. Design stacks under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.7 REGULATORY REQUIREMENTS

A. Conform to NFPA 54 (ANSI Z223.1) code for installation of natural gas burning appliances and equipment.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 TYPE B DOUBLE WALL GAS VENTS

A. Acceptable Manufacturers:

1. American Metal Products
2. Selkirk Metalbestos
3. Metal Fab, Inc.

B. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

C. Mechanically Actuated Vent Dampers: Same size as draft hood collar, constructed of stainless steel or galvanized steel, with corrosion-resistant components, in compliance with ANSI Z21.67.

2.2 DOUBLE WALL METAL STACKS

A. Acceptable Manufacturers:

1. Van-Packer Co.
2. Selkirk Metalbestos
3. American Metal Products

B. Provide double wall metal stacks, tested to UL 641 and UL listed, for use with building heating equipment, in compliance with NFPA 211.

C. Fabricate with 25 mm minimum air space between walls. Construct inner jacket of 0.9 mm ASTM A167 Type 304 stainless steel. Construct outer jacket of Type 304 stainless steel 0.6 mm for sizes 254 mm to 610 mm and 0.9 mm for sizes 711 mm to 1219 mm.

D. Accessories, UL labeled:

1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.

Modular Design System

2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.

3. Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54 (ANSI Z223.1).

C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 3.7 m spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

F. Coordinate installation of dampers, and induced draft fans. Refer to Section 16180.

G. Insulate breechings in accordance with Section 15280.

H. For Type B double wall gas vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.

I. Install vent dampers, locating close to draft hood collar, and secured to breeching.

J. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement to ASTM C105. Connect base section to foundation using anchor lugs.

K. Level and plumb chimney and stacks.

L. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

M. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

N. Provide Type B chimney continuously from appliances.

3.2 SCHEDULES

A.

EQUIPMENT	CHIMNEY/STACK
Boiler	Double Wall
Water Heater	Type B
Infrared Heater	Double Wall
Heating/Ventilating Units	Double Wall

END OF SECTION

SECTION 15624

INDIRECT FIRED AIR UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Indirect fired make-up air heater.

B. Controls.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

B. ANSI/UL 207 - Refrigerant - Containing Components and Accessories, Non-Electrical.

C. ANSI/UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

D. ANSI/Z223.1 (NFPA 54) - National Fuel Gas Code.

E. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.

F. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS: Submit shop drawings under provisions of Section 15010.

A. Submit shop drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.

B. Product Data: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate

data, and wiring diagrams.

C. Manufacturer's Installation Instructions: Indicate rigging, assembly, and installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation data under provisions of Section 15010.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.5 WARRANTY

A. Provide five year warranty under provisions of Section 15010.

1.6 MAINTENANCE SERVICE

A. Furnish service and maintenance of units for one year from Date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Provide two sets of filters under provisions of Section 01700.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Applied Air

B. Rapid Engineering, Inc.

C. Rupp Industries, Inc.

2.2 MANUFACTURED UNITS

A. Unit: Indoor unit with factory furnished mixing dampers.

Modular Design System

B. Construction and Ratings: In accordance with ARI 210/240 [, and ANSI/UL 207 and ANSI/UL 303]. Testing: ASHRAE 14.

2.3 FABRICATION

A. Casing and Components: Steel Panels, 1.2 mm reinforced with structural angles and channels to ensure rigidity; access panels to burner and blower motor assemblies from either side of unit.

B. Observation Port: On burner section for observing main and pilot flames.

C. Insulation: Neoprene faced glass fiber insulation 25 mm thick on complete unit.

D. Finish: Heat resistant baked enamel.

2.4 BURNERS

A. Assembly: Forced draft, for natural gas, capable of modulating turn down ratio of 25:1, including electric modulating main gas valve, motorized shut down valve, main and pilot gas regulators, pilot electric gas valve, manual shut-off valve and pilot adjustment valve.

B. Pilot: Electrically ignited by spark rod through high voltage ignition transformer and supervised.

C. Damper: Motorized with end switch to prove position before burner will fire. Damper actuator shall be as specified in Section 15951.

D. Heat Exchanger: Constructed of welded stainless steel.

E. Flue Gas Collector and Draft Hood: Integral with burner casing.

2.5 FAN

A. Fan: Statically and dynamically balanced centrifugal fan

mounted on solid steel shaft with heavy duty self-aligning pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.

2.6 CONTROLS

A. Controls: Coordinate with Section 15951. Provide burner ignition and safety control with this unit. Damper positioning and modulation of burner to be provided by DDC system.

B. Interlocks: Unit to start when exhaust fan is running. Burner to operate when flow switch located in exhaust duct proves flow.

C. Safety Controls: Sense correct air flow before energizing pilot and sense pilot ignition before activating main gas valve.

D. Manual Reset Low and High Limit Controls: Maintain supply air temperature between set points and shut fan down if temperatures are exceeded.

E. Purge Period Timer: Automatically delays burner ignition and bypass low limit control.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions. Coordinate access to units from catwalks indicated.

B. Install in accordance with NFPA 90A.

C. Install in accordance with ANSI Z223.1 (NFPA 54).

END OF SECTION

SECTION 15671

AIR COOLED CONDENSING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Condensing unit package.

B. Charge of refrigerant and oil.

C. Controls and control connections.

D. Refrigerant piping connections.

E. Motor starters.

F. Electrical power connections.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

B. ANSI/ASHRAE 90A - Energy Conservation in new Building Design.

C. ANSI/NEMA MG 1 - Motors and Generators.

D. ANSI/UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.

E. ANSI/UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

F. ANSI/UL 465 - Central Cooling Air Conditioners.

G. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

H. ARI 520 - Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units.

Modular Design System

I. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.

J. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

1.3 SUBMITTALS: Submit shop drawings under provisions of Section 15010.

A. Shop drawings: Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.

B. Product Data: Submit product data indicating rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams.

C. Design Data: Submit design data indicating pipe and equipment sizing.

D. Installation Instructions: Submit manufacturer's installation instructions under provisions of Section 15010.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 15010.

B. Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 15010.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

C. Protect units on site from physical damage. Protect coils.

Modular Design System

1.6 WARRANTY

A. Provide five year warranty under provisions of Section 15010.

B. Warranty: Include coverage for refrigerant compressors.

1.7 EXTRA MATERIALS

A. Provide one complete change of lubricating oil under provisions of Section 01700.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Carrier Corp.

B. Trane Co.

C. Snyder General Corp.

D. York International Corp.

2.2 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, controls, liquid receiver, and screens.

B. Construction and Ratings: In accordance with ARI 210/240. Testing shall be in accordance with ASHRAE 14.

C. Performance Ratings: Energy Efficiency Rating (EER) not less than prescribed by ANSI/ASHRAE 90A.

2.3 CASING

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

B. Mount starters and controls in weatherproof panel provided

with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners.

2.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 2930 kPa, and vacuum dehydrate. Seal with holding charge of refrigerant.

B. Coil Guard: PVC coat steel wire.

2.5 FANS AND MOTORS

A. Horizontal discharge direct driven propeller type condenser fans with fan guard on discharge.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor, with permanent lubricated ball bearings and built in thermal overload protection. Refer to Section 15170.

2.6 COMPRESSORS

A. Construction: Hermetic reciprocating type with heat treated forged steel or cast iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, suction and discharge valves, and sealing surface immersed in oil.

B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators. Internally isolate hermetic units on springs. Refer to Section 15245.

C. Lubrication System: Oil pump with oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer.

D. Motor: Constant speed [1800] [3600] rpm suction gas cooled with electronic sensor and winding over temperature

protection, designed for across-the-line starting. Refer to Section 15170. Furnish with starter.

E. Crankcase Heater: Evaporates refrigerant returning to crankcase during shut down. Energize heater continuously.

2.7 REFRIGERANT CIRCUIT

A. Provide each unit with one refrigerant circuit, factory supplied and piped.

B. Provide the following for each refrigerant circuit:

1. Filter dryer.
2. Liquid line sight glass and moisture indicator.
3. Insulated suction line.
4. Suction and liquid line service valves.
5. Charging valve.
6. Discharge line check valve.
7. Compressor discharge service valve.
8. Condenser pressure relief valve.

2.8 CONTROLS

A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection.

B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the- line starter with starter relay.

C. Provide the following safety controls arranged so that operating any one will shut down machine and require manual reset:

1. High discharge pressure switch (manual reset).

2. Low suction pressure switch (automatic reset).
3. Oil Pressure switch (manual reset).

Modular Design System

D. Provide the following operating controls:

1. Thermostat located in room cycles compressor.

2. Five minute off timer prevents compressor from short cycling.

E. Provide electric solid state microcomputer based room thermostat, located as indicated.

F. Room thermostat display shall include:

1. Time of Day.
2. Actual room temperature.
3. Programmed temperature.
4. Programmed time.
5. Duration of timed override.
6. Day of week.
7. System mode indication: Cooling, auto, off, fan auto, fan on.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service. Refer to Section 16180.

C. Install units on vibration isolation. Refer to Section 15245.

D. Provide connection to refrigeration piping system and evaporators. Comply with ANSI/ASHRAE 15.

3.2 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up, including routine servicing and check out.

Modular Design System

B. Supply initial charge of refrigerant and oil for each refrigerant circuit. Replace losses of refrigerant and oil.

C. Inspect and test for refrigerant leaks every 4 months during first year of operation.

END OF SECTION

SECTION 15681

PACKAGED WATER CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Chiller package.

B. Charge of refrigerant and oil.

C. Controls and control connections.

D. Chilled water connections.

E. Starters.

F. Electrical power connections.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ANSI/ARI 590 - Positive Displacement Compressor Water-Chilling Packages.

B. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code.

C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

D. ANSI/UL 465 - Central Cooling Air Conditioners.

E. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS: Submit shop drawings under provisions of Section 15010.

A. Shop Drawings: Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate valves, strainers, and thermostatic valves required

for complete system.

B. Product Data: Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

C. Certification: Submit written certification that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.

D. Installation Instructions: Submit manufacturer's installation instructions under provisions of Section 15010.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation data under provisions of Section 15010.

B. Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

C. Submit maintenance data under provisions of Section 15010.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/ARI 590 code for testing and rating of reciprocating water chillers.

B. Conform to ANSI/UL 465 code for construction of reciprocating water chillers and provide UL label.

C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of reciprocating water chillers.

D. Conform to ANSI/ASHRAE 15 code for construction and operation of reciprocating water chillers.

E. Provide certification of inspection for conforming authority having jurisdiction approval.

1.6 DELIVERY, STORAGE, AND HANDLING

Modular Design System

A. Deliver products to site under provisions of Section 15010.

B. Store and protect products under provisions of Section 15010.

C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

D. Protect units from physical damage.

1.7 WARRANTY

A. Provide five year warranty under provisions of Section 15010.

B. Warranty: Include coverage for complete assembly including materials and labor.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of complete assembly for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Carrier Corp.

B. Dunham-Bush, Inc.

C. Snyder General Corp.

D. Trane Company

E. York International Corp.

2.2 MANUFACTURED UNITS

A. Provide factory assembled and tested air cooled liquid chillers consisting of compressors, condensers, evaporator, thermal expansion valve, refrigeration accessories, and

control panel. Construction and ratings shall be in accordance with ANSI/ARI 590.

2.3 COMPRESSORS

A. Reciprocating Compressors: Provide with forced-feed lubrication, crankcase heater, hot-gas muffler and suction strainer. Cylinder unloading devices shall be unloaded when compressor starts. Piston speed for open compressors shall not exceed recommendations of manufacturer or 1000 feet per minute (fpm), whichever is less.

B. Helical Rotary Compressors: Positive displacement, oil injected type, and driven by an electric motor. Rotors shall be solid steel, Society of Automotive Engineers Grade 1141 or 1144. Shaft main bearings shall be either sleeve-design type with leaded bronze or steel-backed babbit; or frictionless bearing design, ball or roller type. Housing and covers shall be high-grade cast-iron pressure castings. Lubrication systems shall lubricate rotors, bearings, shaft seal as well as rotor sealing and cooling. Provide an oil safety cutout interlocked with the compressor starter to allow compressor to operate only when oil management system is operational. Provide for lubrication of bearings and shaft seals on shutdown with or without electric power supply.

C. Scroll Compressors: Three-dimensional, compliant, hermetically sealed design. Compressors shall be mounted on vibration isolators. Rotating parts shall be factory balanced. Main bearings shall be rolling-element type. Lubrication systems shall be centrifugal pump type include in oil level sight glass and oil charging valve.

D. Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators. Refer to Section 15245.

E. Provide reversible, positive displacement, oil pump lubrication system with oil charging valve, oil level sight glass, oil filter, and magnetic plug on strainer, arranged to ensure adequate lubrication during starting, stopping, and

normal operation.

F. Provide compressor with automatic capacity reduction equipment consisting of suction valve unloaders. Provide for unloaded compressor start.

G. Provide constant speed 1800 rpm compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection, designed for part winding starting. Refer to Section 15170. Furnish with starter.

H. Provide crankcase heater to evaporate refrigerant returning to crankcase during shut down. Energize heater when compressor is not operating.

2.4 EVAPORATOR

A. Provide evaporator of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Provide multiple refrigerant circuits on multiple compressor units.

B. Design, test, and stamp refrigerant side for 1550 kPa working pressure and water side for 1030 kPa working pressure, in accordance with ANSI/ASME SEC 8.

C. Insulate with 19 mm minimum thick flexible expanded polyvinyl chloride insulation with maximum K value 0.037 watts/m*○K.

D. Provide water drain connection and thermometer wells for temperature controller and low temperature cutout.

2.5 CONDENSERS

A. Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits with liquid accumulators. Air test under water to 2930 kPa.

B. Provide vertical discharge direct driven propeller type

condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing. Provide factory mounted, louvered, galvanized steel coil guard panels.

C. Provide fan motors with permanently lubricated ball bearings and built-in current and overload protection. Refer to Section 15170.

2.6 ENCLOSURES

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

B. Mount starters and disconnects in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

2.7 REFRIGERANT CIRCUIT

A. Provide refrigerant circuits, factory supplied and piped.

B. Provide for each refrigerant circuit:

1. Liquid line solenoid valve.
2. Filter dryer (replaceable core type).
3. Liquid line sight glass and moisture indicator.
4. Thermal expansion for maximum operating pressure.
5. Charging valve.
6. Insulated suction line.
7. Discharge line check valve.
8. Compressor discharge service valve.
9. Pressure relief device.

2.8 CONTROLS

A. Locate on chiller, mount steel control panel, containing starters, power and control wiring, molded case disconnect switch, factory wired with single point power connection.

B. For each compressor, provide part winding starter,

non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection.

C. Provide the following devices on control panel face:

1. Compressor run lights.

2. System start-stop switch.

3. Control power fuse of circuit breaker.

4. Compressor lead-lag switch.

5. Demand limit switch.

D. Provide the following safety controls with indicating lights arranged so that operating any one will shut down machine and require manual reset:

1. Low chilled water temperature switch.

2. High discharge pressure switch for each compressor.

3. Low suction pressure switch for each compressor.

4. Oil pressure switch.

5. Flow switch in chilled water line.

6. Relay for remote mounted emergency shut-down.

E. Provide the following operating controls:

1. Multi-step chilled water temperature controller which cycles compressor and activates cylinder unloaders.

2. Five minute off timer prevents compressor from short cycling.

3. Part winding start timer.

4. Periodic pump-out timer to pump down on chilled water flow and high evaporator refrigerant pressure.

5. Load limit thermostat to limit compressor loading on high return water temperature.

6. Three phase monitor to protect unit by stopping compressor on phase loss, phase reversal, phase unbalance, or under voltage.

7. Hot gas bypass sized for minimum compressor loading on one compressor only, bypasses hot refrigerant gas to evaporator.

8. Cycle counter and operating hour meter.

F. Provide pre-piped gage board with pressure gages for suction and discharge refrigerant pressures, and oil pressures [for each compressor. Gage board shall also be equipped with temperature gages for inlet and outlet water temperatures, suction and condensing refrigerant temperature, and ambient temperature. Digital display of the above on the unit control panel may be provided in lieu of a gage board.

G. Provide alarm package with test button and indicating lights which indicate control circuit is energized and compressor is running, and will sound an audible alarm and light an indicating light upon detection of compressor malfunction, low chilled water temperature, or evaporator water flow failure.

H. The unit shall be connected to the facility DDC control system. All control parameters and alarms shall be accessible through the DDC connection, and at a future date, to the basewide EMCS.

PART 3 EXECUTION

3.1 INSTALLATION

Modular Design System

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service. Refer to Section 16180.

C. Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.

D. Install units in vibration isolation. Refer to Section 15245.

E. Provide connection to chilled water piping. Refer to Section 15510. On inlet, provide thermometer well for temperature controller, thermometer, flow switch, pressure gage shut- off valve. On outlet, provide thermometer, pressure gage, shut-off valve.

F. Arrange piping for easy dismantling to permit tube cleaning.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 15010.

B. Supply service of factory trained representative for a period of 2 days to supervise testing, dehydration and charging of machine, start-up, and instruction on operation and maintenance to Owner.

C. Supply initial charge of refrigerant and oil.

END OF SECTION

SECTION 15784

UNITARY AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unitary air conditioners.

B. Controls.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ARI 210 - Unitary Air Conditioning Equipment.

B. NFPA 70 - National Electrical Code.

C. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

D. UL 465 - Central Cooling Air Conditioners.

1.3 SUBMITTALS: Section 15010 - Submittals: Procedures for submittals.

A. Product Data: Provide data for manufactured products and assemblies. Indicate water, drain, thermostatic valves, and electrical rough-in connections with electrical characteristics and connection requirements.

1.4 SUBMITTALS FOR INFORMATION

A. Section 15010 - Submittals: Procedures for submittals.

B. Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

1.5 REGULATORY REQUIREMENTS

Modular Design System

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.6 WARRANTY

A. Provide a five year warranty.

1.7 EXTRA MATERIALS

A. Provide one set of filters for each unit.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier Corp.

B. Trane Co.

C. Snyder General Corp.

D. York International Corp.

2.2 AIR CONDITIONING UNITS

A. Description: Packaged, self-contained, factory assembled, prewired unit, consisting of cabinet, evaporator fan, evaporator coil, discharge louvers, air filters, and controls; fully charged with refrigerant and filled with oil.

B. Assembly: Horizontal flow air delivery, in draw-through ceiling suspended configuration as indicated.

C. Electrical Characteristics:

1. Refer to Section 16180.

2.3 CABINET

A. Frame and Panels: Galvanized steel with baked enamel finish,

easily removed access doors or panels with quick fasteners.

B. Insulation: Minimum 13 mm thick acoustic duct liner for lining cabinet interior.

C. Drain Pan: Galvanized steel with corrosion-resistant coating. Integral float controlled condensate pump.

2.4 EVAPORATOR FAN

A. Fan: Direct drive, forward curved centrifugal fan, statically and dynamically balanced, resiliently mounted.

B. Motors: Refer to Section 15170.

2.5 EVAPORATOR COIL

A. Direct expansion coiling coil of seamless copper or aluminum tubes expanded into aluminum fins.

2.6 AIR FILTERS

A. Easily removed 25 mm thick permanent cleanable panel filters.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Pipe refrigerant from unit to condenser.

C. Pipe condensate from drain pan to nearest floor drain as indicated.

END OF SECTION

SECTION 15790

AIR COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water coils.

B. Glycol coils.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ANSI/ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

B. NFPA 70 - National Electrical Code.

C. ANSI/UL 1096 - Electric Central Air Heating Equipment.

D. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.3 SUBMITTALS: Submit shop drawings under provisions of Section 15010.

A. Shop Drawings: Submit shop drawings indicating coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

B. Product Data: Submit product data indicating coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

C. Installation Instructions: Submit manufacturer's installation instructions under provisions of Section 15010.

D. Certificate: Submit manufacturer's certificate under provisions of Section 15010 that coil capacities, pressure

drops, and selection procedures meet or exceed specified requirements.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 15010.

B. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

C. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - HYDRONIC

A. Carrier Corp.

B. Dunham-Bush, Inc.

C. Snyder General Corp.

D. Trane Company

E. York International Corp.

2.2 FABRICATION

A. Tubes: 16 mm OD seamless copper or brass arranged in parallel or staggered pattern, expanded into fins, silver brazed joints.

B. Fins: Aluminum or copper continuous plate type with full fin collars or individual helical finned tube type wound under

tension. Solder coat copper fin coils.

C. Casing: Die formed channel frame of gage 1.6 mm galvanized steel with 9.5 mm mounting holes on 152 mm centers. Provide tube supports for coils longer than 1016 mm.

D. Capacity: As scheduled.

2.3 WATER HEATING COILS

A. Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.

B. Testing: Air test under water to 2410 kPa for working pressure of 1380 kPa 104 degrees C.

C. Configuration: Drainable, with threaded plugs in headers for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

D. Fin Spacing: As required.

2.4 GLYCOL COOLING COILS

A. Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.

B. Testing: Air test under water to 2410 kPa for working pressure of 1380 kPa and 104 degrees C.

C. Configuration: Drainable, with threaded plugs in headers for drain and vent; threaded plugs in return bends and in headers opposite each tube.

D. Fin Spacing: As required.

PART 3 EXECUTION

Modular Design System

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

C. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for maximum three coil sections. Arrange supports to avoid piercing drain pans. Provide airtight seal between coil and duct or casing.

D. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

E. Install coils level.

F. Make connections to coils with unions and flanges.

G. On water coils, provide shut-off valve on supply line and lockshield balancing valve on return line. Locate water supply at bottom of supply header and return water connection at top. Provide float operated automatic air vents at high points complete with stopvalve. Ensure water coils are drainable and provide drain connection at low points.

H. On water and glycol coils, connect water supply to leaving air side of coil (counterflow arrangement).

I. For cooling coils where air velocity exceeds 2.5 m/sec, provide three break moisture eliminators of 0.70 mm galvanized steel.

J. Provide drain pan and drain connection for cooling coils. Fabricate drain pan from 1.00 mm galvanized steel. Extend 76 mm from face of coil entering air side, 152 mm from face of coil leaving air side, 102 mm from face of eliminators. Pipe drain pans individually to floor drain with water seal trap.

K. Insulate headers located outside air flow as specified for

piping. Refer to Section 15260.

END OF SECTION

SECTION 15835

TERMINAL HEAT TRANSFER UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit heaters.

B. Infrared heaters.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS: Submit shop drawings under provisions of Section 15010.

A. Shop Drawings: Submit shop drawings indicating cross section of cabinets, grille, bracing and reinforcing, and typical elevation.

B. Product Data: Submit product data indicating typical catalog of information including arrangements.

C. Schedules: Submit schedules of equipment and enclosures.

D. Service Location: Indicate mechanical and electrical service locations and requirements, specifically indicating deviations from indicated products.

E. Installation Instructions: Submit manufacturer's installation instructions under provisions of Section 15010.

1.4 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 15010.

1.5 OPERATION AND MAINTENANCE DATA

Modular Design System

A. Submit operation and maintenance data under provisions of Section 15010.

B. Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 15010.

B. Store and protect products under provisions of Section 15010.

C. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.9 SEQUENCING AND SCHEDULING

A. Sequence work under the provisions of Section 01570.

1.10 WARRANTY

A. Provide five year manufacturer's warranty under provisions of Section 15010.

B. Warranty: Include coverage of unit heater motors.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - UNIT HEATERS

Modular Design System

A. Carrier Corp.

B. Modine Mfg Co.

C. Snyder General Corp.

D. Trane Company

E. York International Corp.

2.2 UNIT HEATERS

A. Coils: Seamless copper tubing, 0.64 mm minimum wall thickness, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

B. Casing: 1.3 mm steel with threaded pipe connections for hanger rods.

C. Finish: Factory apply baked primer coat on visible surfaces of enclosure or cabinet.

D. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

E. Air Outlet: Adjustable pattern diffuser on projection models and four way louvers on horizontal throw models.

F. Motor: Refer to Section 15170; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

G. Control: Local disconnect switch.

H. Capacity: Based on 18 degree C entering air temperature, 82 degree C average water temperature.

2.3 VENTED GAS INFRARED HEATER

Modular Design System

Low intensity pipe style, natural gas fired.

A. Vent: NFPA 54 and NFPA 211. Vent flue gas and combustion air to outdoors.

B. Reflector: Polished aluminum or approved high infrared reflector materials. Provide manufacturer's standard reflector supports.

C. Heat Exchanger and Combustion Chamber: Construct heat exchanger and combustion chamber of aluminum-clad steel or stainless steel.

D. Controls: Incorporate either an intermittent pilot ignition system or a solid-state direct ignition system. Provide safety air-flow switch for each burner.

E. Fan or Vacuum Pump: Heater manufacturer's standard.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Hang unit heaters from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

C. Protect units with protective covers during balance of construction.

D. Provide hydronic units with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For unit heaters, provide float operated automatic air vents with stop valve.

E. Hang infrared heaters from building structure. Maintain manufacturer minimum clearances to combustibles. Locate burners and vacuum pumps for convenient access from catwalk indicated. Provide wind bracing in longitudinal and transverse direction to inhibit swinging of pipe/reflector assembly.

3.3 CLEANING

A. Clean work under provisions of Section 15010.

B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

C. Touch-up marred or scratched surfaces of factory-finished

Modular Design System

cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 15855

AIR HANDLING UNITS WITH COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged air handling units.

B. Heating coils.

C. Combination filter/mixing boxes.

D. Cooling coils.

E. Humidifiers.

1.2 CODES AND STANDARDS
(Latest edition or revision).

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

E. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.

F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Roller Bearings.

G. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

H. UL 181 - Factory-made Air Ducts and Connectors.

I. UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

J. ANSI/UL 900 - Test Performance of Air Filter Units.

K. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

L. ARI 430 - Standard for Central-Station Air-Handling Units.

M. ARI 435 - Standard for Application of Central-Station Air-Handling Units.

N. ARI 610 - Central System Humidifiers.

O. NFPA 70 - National Electrical Code

P. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

Q. SMACNA - HVAC Duct Construction Standards - Metals and Flexible.

R. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

S. ASHRAE 52 - Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

T. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedures for Fans.

U. IEEE 112 - Standard Test Procedure for Polyphase Induction Motors and Generators.

V. NEMA MG1 - Motors and Generators.

W. NEMA MG 10 - Energy Management Guide for Selection and Use of Polyphase Motors.

X. CIDA-A-1419 - Filter Element, Air-Conditioning, (Viscous - Impingement and Dry Types, Replaceable).

Modular Design System

1.3 QUALITY ASSURANCE

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99 and ARI 430.

D. Filter Media: ANSI/UL 900 listed, Class I or Class II, approved by local authorities.

E. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

F. Air Handling Units: Products of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

G. Humidifiers: Certify capacities and selection in accordance with ARI 610.

1.4 SUBMITTALS: Submit shop drawings and product data under provisions of Section 15010.

A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Product Data:
   1. Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gages and finishes of materials, and electrical characteristics and connection requirements.
   2. Provide data of filter media, filter performance data, filter assembly, and filter frames.
   3. Provide fan curves with specified operating point clearly plotted.
   4. Submit sound power level data for both fan outlet and

casing radiation at rated capacity.

5. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Installation Instructions: Submit manufacturer's installation instructions.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit six operation and maintenance manuals under provisions of Section 15010 shall list step-by-step procedures required for system startup, operation, shutdown, and routine maintenance at least 2 weeks prior to field training.

B. The manuals shall include the manufacturer's name, model number, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

C. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement,

D. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience, who issues complete catalog data on total product.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect products to site under provisions

of Section 15010.

B. Accept products on site under provisions of Section 15010 in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store in clean dry place and protect from construction traffic, weather, humidity and temperature variations, dirt and dust, or other contaminants. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 EXTRA MATERIALS

A. Provide one set of disposable filters and fan belts under provisions of Section 01700.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier Corp

B. Snyder General Corp.

C. Trane Company

D. York International Corp.

2.2 GENERAL DESCRIPTION

A. Air Handling Units shall be single zone draw-thru type as indicated.

Modular Design System

B. Configuration: Fabricate with fan plus accessories, including:

1. Heating coil section.
2. Combination filter/mixing box section.
3. Cooling coil section.
4. Humidifier.
5. Vibration isolators.

C. Factory fabricate and test air handling units of sizes, capacities, and configuration as indicated and specified in accordance with AMCA 99 and ARI 430.

D. Base performance on local site conditions.

2.3 CASING

A. Construction: Construct of 1.6 mm galvanized steel on channel base or drain pan. Fabricate channel base, and drain pans, or welded steel coated externally with zinc chromate, iron oxide, or phenolic resin paint. Inner casing of double-wall units shall be minimum 1.0 mm galvanized steel.

B. Insulation: Insulate casing sections with 38 mm thick, 24 kg/cu. m density, neoprene coated, glass fiber insulation, "ksi" value at 42 degrees C maximum 0.037 Watts/m*Degree K, sandwiched between inner and outer wall of mill galvanized steel, with support members. Insulation shall conform to NFPA 90A.

C. Access Doors: Provide casings with access doors as indicated. Access doors shall be insulated, fully gasketed, double wall type, of a minimum 1.3 mm outer and 1.0 mm inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Access doors shall be a minimum 610 mm wide and shall be full height of the unit casing or a minimum of 1829 mm, whichever is less. Provide minimum 203 mm x 203 mm inspection window of 6 mm thick plexiglass.

D. Drain Pans: Construct drain pans from double thickness 1.6 mm galvanized steel with insulation between layers, with

welded corners. Cross break and pitch to drain connection. Provide drain pans under cooling coil section, with asphalt base coating.

E. Strength: Provide structure to brace casings for suction pressure of 620 Pa, with maximum deflection of 1 in 200.

F. Lights: Provide lights in accessible sections with wire guards, factory wired to weatherproof switch and duplex outlet mounted on casing exterior.

2.4 FANS

A. Type: Provide fan section with air foil, double width, double inlet, centrifugal type fan as scheduled on Mechanical drawings. Refer to Section 15860.

B. Bearings: Provide self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of fan casing with aluminum tube and grease fittings rigidly attached to casing on drive side of air handler.

C. Mounting: Locate fan and motor internally on welded steel base coated with zinc chromate. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through hinged access doors. Mount rails on vibration isolators. Refer to Section 15245.

D. Flexible Connection: Separate fan and coil sections with flexible connection. Refer to Section 15910.

2.5 MOTOR AND DRIVES

A. Motors: As indicated, in compliance with Section 15170.

B. Bearings: Fan bearings shall be sealed against dust and dirt, and shall be precision, self-aligning, grease-lubricated, heavy duty pillow block, ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA 9 and AFBMA 11.

C. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

D. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch sheaves for motors 15 kW and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 18.7 kW and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

E. Belt Guard: Fabricate to SMACNA Standards; 2.8 mm thick, 19 mm diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.6 COILS

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 610 mm downstream of coil] and down spouts for cooling coil banks more than one coil high.

C. Air Coils: Provide coils indicated for water cooling and hot water heating. Certify capacities, pressure drops, and selection procedures in accordance with ARI 410. Refer to Section 15790.

2.7 HUMIDIFIERS

Factory-assembled, single or multiple units as required to obtain the capacities indicated.

A. Steam Dispersion Panel: Unit shall inject steam directly into the air stream.

Modular Design System

1. For duct-mounted units, equip each unit with a stainless steel distribution grid, consisting of multiple distributio headers, with pipe connection on one end and cap on the other end. Evenly space orifices across grid face. Provide gas-fired steam generator. House grid in copper enclosures with built-in condensate drain collector for enclosed-grid type. Grid design shall provide for complete steam absorption within 600 mm.

2. Steam Units: Self-contained, gas-fired steam generators with steam output as indicated. Provide each unit with a forced draft burner control circuit to control steam output and compensate for changing water conditions without chemical additives. Include an integral control and monitoring panel, with a capacity meter, a capacity adjustment control adjusting 2.5% to 100 percent of rated output capacity, an on-off drain switch, and an on-auto push button with indicator light. Unit shall accept a 4-20 mA input signal to set steam generation rate. Equip each unit with double-wall insulated steam supply hose, a steam distribution grid as in a. above, an automatic fill with cleanable strainers, or an automatic drain valve. Gas venting connections shall be in accordance with NFPA 54.

2.8 FILTERS

A. Filter Box: Provide section with filter guides, access doors from both sides, for side loading.

B. Provide section with angle arrangement with 51 mm deep disposable panel filters. Refer to Section 15885.

C. Filter Gauges: Provide 89 mm diameter diaphragm actuated dial in metal case, with static pressure tips. Refer to Section 15980.

2.9 DAMPERS

A. Mixing Boxes: Provide section with factory mounted outside

and return air dampers of galvanized steel with vinyl bulb edging and edge seals in galvanized frame, with galvanized steel axles in self-lubricating nylon bearings, in opposed blade arrangement with damper blades positioned across short air opening dimension. Provide removable, full width rack for supporting freeze protection thermostat, with removable end panel to permit rack removal. Provide mixing box with integral angle filter rack for 51 mm deep, disposable, pleated media filters. Filter/mixing box shall have access doors for filter access.

B. Damper Leakage: Maximum 2 percent at 1000 Pa differential pressure when sized for 10 m/sec face velocity.

PART 3 EXECUTION

3.1 INSTALLATION

A. Work shall be installed as shown and in accordance with manufacturer's instructions, diagrams and recommendations and in conformance with ARI 435. Frames and supports shall be provided for items requiring supports.

B. Assemble high pressure units by bolting sections together. Isolate fan section with flexible duct connections.

C. Install each air handling unit on a concrete housekeeping pad. Refer to Section 15010.

D. Install each filter type in accordance with manufacturer's directions.

E. Arrange installation of units to provide access space around air handling unit for service and maintenance.

F. Access panels shall be provided of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced.

3.2 CONNECTIONS

Modular Design System

A. Arrange piping connections adjacent to units to allow unit servicing and maintenance.

B. Extend condensate drain lines to nearest floor drain and as indicated on mechanical drawings.

C. Install flexible duct connections to unit components and as indicated on mechanical drawings.

3.3 PERFORMANCE TESTS

A. Fan operation shall be stable over the entire volume range of the system.

3.4 CLEANING AND ADJUSTING

A. Temporary filters shall be provided for all air handling units that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenum, casings, and other items specified have been vacuum cleaned.

B. Air handling units shall be maintained in this clean condition until final acceptance.

C. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer.

D. Belts shall be tightened to proper tension.

E. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

END OF SECTION

SECTION 15860

CENTRIFUGAL FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tubular centrifugal fans.

B. Inline centrifugal fans.

C. Utility/vent sets.

D. Motors and drives

E. Fan Accessories.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA 99 - Standards Handbook.

D. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes

E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

F. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

G. NEMA MG1 - Motors and Generators.

H. NFPA 70 - National Electrical Code.

I. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

J. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

1.7 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide two sets of belts for each fan.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Acme Engineering & Mfg Corp.

B. Bayley Fan Group

C. Greenheck Fan Corp.

D. Loren Cook Co.

E. Snyder General Corp.

F. Trane Company

2.2 GENERAL

A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300.

C. Fabrication: Conform to AMCA 99.

D. Performance Base: Sea level conditions.

E. Temperature Limit: Maximum 150 degrees C.

F. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.3 WHEEL AND INLET

A. Backward Inclined: Steel or aluminum construction with smooth

curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws. Provide sparkproof construction for battery and chemical storage cabinet.

2.4 HOUSING

A. Heavy gage steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off. Provide sparkproof construction for battery and chemical storage exhaust.

B. Factory finish before assembly with enamel or prime coat. Prime coating on aluminum parts is not required.

C. Provide bolted construction with horizontal flanged split housing.

2.5 BEARINGS AND DRIVES

A. Bearings: AFBMA 9, L-10 life at 50,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, or AFBMA 11 L-10 life at 120,000 hours pillow block type, self-aligning, grease-lubricated roller bearings.

B. Shafts: Hot rolled steel, ground and polished, with key- way, protectively coated with lubricating oil, and shaft guard.

C. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 11.2 Kw and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 15 Kw and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

D. Belt Guard: Fabricate to SMACNA Standard; of 2.8 mm thick, 19 mm diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports

without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:

1. Refer to Section 16180.

B. Motor: Refer to Section 15170.

C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.7 ACCESSORIES

A. Fixed Inlet Vanes: Steel construction with fixed cantilevered inlet guide vanes welded to inlet bell.

B. Inlet/Outlet Screens: Galvanized steel welded grid.

C. Access Doors: Shaped to conform to scroll, with quick opening latches and gaskets.

D. Scroll Drain: 13 mm steel pipe coupling welded to low point of fan scroll.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install fans as indicated, with resilient mountings and flexible electrical leads. Refer to Section 15245.

C. Install flexible connections specified in Section 15910 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and fan while running.

D. Install fan restraining snubbers as required. Refer to Section 15245. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

E. Provide fixed sheaves required for final air balance.

F. Provide safety screen where inlet or outlet is exposed.

G. Pipe scroll drains to nearest floor drain.

H. Provide backdraft dampers on discharge of exhaust fans and as indicated. Refer to Section 15910.

END OF SECTION

SECTION 15865

AXIAL FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Propeller fans.

B. Motors and drives.

C. Accessories.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA 99 - Standards Handbook.

D. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

F. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

G. NEMA MG1 - Motors and Generators.

H. NFPA 70 - National Electrical Code.

I. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

J. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Shop Drawings: Indicate assembly of axial fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

B. Product Data: Provide data on axial fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.6 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide two sets of belts for each fan.

PART 2 PRODUCTS

2.1 PROPELLER FANS

Modular Design System

A. Acceptable Manufacturers:

1. Acme Engineering & Mfg Co.
2. Bayley Fan Group
3. Greenheck Fan Corp.
4. Loren Cook Co.
5. Trane Company

B. Impeller: Shaped steel or steel reinforced aluminum blade with heavy hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or provided with V-belt drive.

C. Electrical Characteristics and Components:

1. Electrical Characteristics:
   a) Refer to Section 16180.
2. Motor: Refer to Section 15170. Self-aligning pre-lubricated ball or sleeve bearings affixed to mounting plate permitting belt tensioning, neoprene vibration isolation between fan assembly and mounting plate.
3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

D. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

E. Backdraft Damper: Multiple blade with offset hinge pin, blades linked.

F. Safety Screens: 25 mm galvanized wire over inlet, motor, and drive and backdraft damper for separate mounting on outlet.

PART 3 EXECUTION

3.1 INSTALLATION

Modular Design System

A. Install in accordance with manufacturer's instructions.

B. Install axial fans as indicated. Install with resilient mountings specified in Section 15245 and with flexible electrical leads.

C. Install flexible connections specified in Section 15910 between axial fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and axial fan while running.

D. Provide fixed sheaves required for final air balance.

E. Provide safety screen where inlet or outlet is exposed.

F. Provide backdraft dampers on discharge of exhaust fans and as indicated.

G. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 15885

AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disposable panel filters.

B. Filter frames.

C. Filter gages.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ARI 850 - Commercial and Industrial Air Filter Equipment.

B. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. NFPA 70 - National Electrical Code.

D. UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

E. UL 867 - Electrostatic Air Cleaners.

F. UL 900 - Test Performance of Air Filter Units.

1.3 PERFORMANCE TOLERANCES

A. Conform to ARI 850 Section 7.4.

1.4 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Shop Drawings: Indicate filter assembly and filter frames and dimensions.

Modular Design System

C. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames.

D. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.

Modular Design System

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

1.6 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide one set disposable panel filters.

PART 2 PRODUCTS

2.1 DISPOSABLE PANEL FILTERS

A. Acceptable Manufacturers:

1. American Air Filter
   (Snyder General Corp)
2. Cam-Farr, Co.
3. Eco-Air Products, Inc.

B. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.

1. Nominal Size: 610 x 610 mm.

2. Thickness: 51 mm.

C. Performance Rating, ASHRAE 52: See Air Filter Schedule.

D. Casing: Cardboard frame with perforated metal retainer.

2.2 FILTER FRAMES AND HOUSINGS

A. Acceptable Manufacturers:

1. American Air Filter

Modular Design System

(Snyder General Corp)
2. Cam-Farr, Co.
3. Eco-Air Products, Inc.
4. Flanders Filters Inc.

B. General: Fabricate filter frames and supporting structures of 1.6 mm galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

C. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 610 x 610 mm filter media, minimum 51 mm thick.

2.3 FILTER GAGES

A. Acceptable Manufacturers:

1. Dwyer Instruments Inc.
2. Honeywell, Inc.

B. Direct Reading Dial: 89 mm diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-250 Pa, 3 percent of full scale accuracy.

C. Accessories: Static pressure tips with integral compression fittings, 6 mm aluminum tubing, 2-way or 3-way vent valves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Install filter gage static pressure tips upstream and

downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

E. Provide filter gages on filter banks, installed with separate static pressure tips upstream and downstream of filters.

END OF SECTION

SECTION 15890

DUCTWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Casing and plenums.

C. Duct cleaning.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASTM A 36 - Structural Steel.

B. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.

E. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

F. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

G. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

H. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

I. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent),

Hot-Rolled Sheet and Strip, Commercial Quality.

J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

K. ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

L. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

M. ASTM C 920 - Elastomeric Joint Sealants.

N. ASTM E 814 - Fire Tests of Through-Penetration Fire Stops

O. AWS D1.1 - Structural Welding Code - Steel.

P. AWS D9.1 - Welding of Sheet Metal.

Q. FS TT-S-001657 - Sealing Compound, Single Component Butyl Rubber Based, Solvent Release Type.

R. NBS PS 15 - Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyestor Chemical Resistant Process Equipment.

S. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

T. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

U. NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying.

V. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

W. SMACNA - HVAC Air Duct Leakage Test Manual.

X. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

Modular Design System

Y. SMACNA - Fibrous Glass Duct Construction Standards.

Z. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: Provide data for duct materials.

B. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

C. Test Pressure Determination: The duct will be constructed for some pressure class (or classes). It is not practical to include duct from two different construction classes in the same leakage test segment. Ducts should not be leak tested at pressures greater than the construction class.

1. Test shall consist of the following: Contractor shall, at the beginning of the work construct, erect and leak test a representative sample of the duct construction to be used at the 0.75 kPa pressure class. The sample specimen shall include at least five transverse joints, typical seams, an access door and at least two typical branch connections plus an elbow. The leakage amount shall not exceed the allotted amount for the pressure class.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional

fittings used.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

B. Maintain one copy of document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing the work of this section with minimum 3 years experience.

1.8 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants for a period of 24 hours.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of

equivalent strength.

C. Insulated Flexible Ducts:

1. Acceptable Manufacturers:

a) Flexmaster USA, Inc.
b) Hart & Cooley, Inc.
c) Thermaflex

2. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.

3. Pressure Rating: 2.50 kPa positive and WG 250 Pa negative.

4. Maximum Velocity: 20.3 m/sec.

5. Temperature Range: -23 degrees C to 71 degrees C.

D. Stainless Steel Ducts: ASTM A167, Type 304 Stainless steel.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant:

1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes.

C. Increase duct sizes gradually, not exceeding 0.26 rad divergence wherever possible; maximum 0.52 rad divergence upstream of equipment and 0.79 rad convergence downstream.

D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 102 mm cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 0.79 rad extended plenum lateral wye takeoffs unless otherwise indicated.

2.3 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

B. Mount floor mounted casings on concrete curbs. At floor, rivet panels on 203 mm centers to angles.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection. Provide clear wire glass observation ports, minimum 152 X 152 mm size.

D. Fabricate acoustic casings with reinforcing turned inward. Provide 1.60 mm back facing and 0.85 mm perforated front facing with 2.4 mm diameter holes on 4 mm centers. Construct panels 76 mm thick packed with 72 kg/cu m minimum glass fiber media, on inverted channels of 1.6 mm.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Duct Sizes are inside clear dimensions.

D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Use crimp joints with or without bead for joining round duct sizes 203 mm and smaller with crimp in direction of air flow.

G. Use double nuts and lock washers on threaded rod supports.

H. Connect flexible ducts to metal ducts with draw bands.

I. Set plenum doors 152 to 305 mm above floor. Arrange door swings so that fan static pressure holds door in closed position.

J. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 CLEANING

A. Clean work under provisions of Section 15010.

B. Clean duct system and force air at high velocity through duct

to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.3 SCHEDULES

A. DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply (System with Cooling Coils)	Galvanized Steel
Medium and High Pressure Supply	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Toilet/Locker Room Exhaust	Aluminum
Chemical Storage Exhaust	Stainless Steel
Battery Room Exhaust	Stainless Steel

B. DUCTWORK PRESSURE CLASS SCHEDULE

AIR SYSTEM	PRESSURE CLASS
Supply (System with Cooling Coils)	500 Pa
Return and Relief	250 Pa
General and Toilet Exhaust	250 Pa
Outside Air Intake	125 Pa
Combustion Air	125 Pa

SAFETY PAYS

Modular Design System

Chemical and Battery Exhaust 500 Pa

END OF SECTION

SECTION 15910

DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers.

C. Combination fire and smoke dampers.

D. Duct access doors.

E. Duct test holes.

F. Fire dampers.

G. Flexible duct connections.

H. Smoke Dampers.

I. Volume control dampers.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. NFPA 92A - Smoke Control Systems.

C. NFPA 70 - National Electrical Code.

D. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

E. UL 33 - Heat Responsive Links for Fire-Protection Service.

F. UL 555 - Fire Dampers and Ceiling Dampers.

G. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of access doors and test holes.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.6 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Protect dampers from damage to operating linkages and blades.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide two of each size and type of fusible link.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with push-pull operator strap.

2.2 BACKDRAFT DAMPERS.

A. Acceptable Manufacturers:

1. Air Balance, Inc.
2. Greenheck
3. Ruskin (Phillips Industries)
4. Vent Products Co., Inc.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 1.6 mm thick galvanized steel, or extruded aluminum, with center pivoted blades of maximum 152 mm width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 1.57 Rad stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

C. Gravity Backdraft Dampers, Size 457 x 457 mm or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturers standard construction.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

Modular Design System

1. Air Balance, Inc.
2. Greenheck
3. Ruskin (Phillips Industries)

B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

C. Provide factory sleeve and collar for each damper.

D. Multiple Blade Dampers: Fabricate with 1.6 mm galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 3 x 13 mm plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 13 mm actuator shaft.

E. Operators: UL listed and labelled spring return electric type suitable for 24 VAC, single phase, 60 Hz. Locate damper operator on exterior of duct and link to damper operating shaft.

F. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.

G. Electro Thermal Link: Fusible link melting at 74 degrees C; 24 VAC, single phase, 60 Hz; UL listed and labeled.

2.4 DUCT ACCESS DOORS

A. Acceptable Manufacturers:

1. Air Balance, Inc.
2. Cesco Products
3. Ruskin (Phillips Industries)
4. Vent Products Co., Inc.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

Modular Design System

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 25 mm thick insulation with sheet metal cover.

1. Less Than 305 mm Square: Secure with sash locks.

2. Up to 457 mm Square: Provide two hinges and two sash locks.

3. Up to 610 x 1220 mm: Three hinges and two compression latches.

4. Larger Sizes: Provide an additional hinge.

D. Access doors with sheet metal screw fasteners are not acceptable.

2.5 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 FIRE DAMPERS

A. Acceptable Manufacturers:

1. Air Balance, Inc.
2. Greenheck
3. Ruskin (Phillips Industries)

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for closure under air flow conditions. Configure with blades out of air stream except for 250 Pa pressure class ducts up to 305 mm in height.

D. Multiple Blade Dampers: 1.6 mm galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 3 x 13 mm plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

E. Fusible Links: UL 33, separate at 71 degrees C with adjustable link straps for combination fire/balancing dampers.

2.7 FLEXIBLE DUCT CONNECTIONS

A. Acceptable Manufacturers:

1. Durodyne Corp.
2. United McGill Corp.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Connector: Fabric crimped into metal edging strip.
1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 1.0 kg/sq m.

Modular Design System

2. Net Fabric Width: Approximately 152 mm wide.

3. Metal: 76 mm wide, 0.70 mm thick galvanized steel.

D. Leaded Vinyl Sheet: Minimum 14 mm thick, 4.2 kg/sq m, 10 dB attenuation in 10 to 10,000 Hz range.

2.8 SMOKE DAMPERS

A. Acceptable Manufacturers:

1. Air Balance, Inc.
2. Ruskin (Phillips Industries)
3. Greenheck

B. Fabricate in accordance with NFPA 90A and UL 5555, and as indicated.

C. Dampers: UL Class 1 curtain type fire damper, normally open automatically operated by electric actuator.

D. Electro Thermal Link: Fusible link melting at 74 degrees C; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.9 VOLUME CONTROL DAMPERS.

A. Manufacturers:

1. Air Balance, Inc.
2. Ruskin (Phillips Industries)
3. Greenheck

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Splitter Dampers:

1. Material: Same gage as duct to 610 mm size in either direction, and two gages heavier for sizes over 610 mm.

2. Blade: Fabricate of double thickness sheet metal to

streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 6 mm diameter rod in self aligning, universal joint action, flanged bushing with set screw.

D. Single Blade Dampers: Fabricate for duct sizes up to 152 x 762 mm.

E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 203 x 1829 mm. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. End Bearings: Except in round ductwork 305 mm and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 762 mm provide regulator at both ends.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 15890 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 203 x 203 mm size for hand access, 457 x 457 mm size for shoulder access, and as indicated. Provide 102 x 102 mm for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.

G. Demonstrate re-setting of fire dampers to Owner's representative.

H. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators. Refer to Section 15245.

I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

J. Use splitter dampers only where indicated.

K. Provide balancing dampers on duct take-off to diffusers,

grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 15940

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

C. Louvers.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ADC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. ARI 650 - Air Outlets and Inlets.

D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

F. NFPA 70 - National Electrical Code.

G. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

Modular Design System

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

PART 2 PRODUCTS

2.1 RECTANGULAR CEILING DIFFUSERS

A. Acceptable Manufacturers:

1. Carnes Co.
2. Krueger Mfg Co.
3. Metalaire
4. Titus Products Div.
5. Tuttle & Bailey

B. Type: Square and rectangular, multi-louvered diffuser to discharge air in 6.28 Rad pattern as scheduled with sectorizing baffles where indicated.

C. Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.

D. Fabrication: Aluminum with baked enamel off-white finish.

E. Accessories: Butterfly damper adjustable from diffuser face.

2.2 CEILING SUPPLY REGISTERS/GRILLES

A. Acceptable Manufacturers:

1. Carnes Co.
2. Krueger Mfg Co.
3. Metalaire
4. Titus Products Div.
5. Tuttle & Bailey

B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

C. Frame: 32 mm margin with countersunk screw mounting and gasket.

D. Fabrication: Aluminum extrusions with factory off-white enamel finish.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.3 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Acceptable Manufacturers:

1. Carnes Co.
2. Krueger Mfg Co.
3. Metalaire
4. Titus Products Div.
5. Tuttle & Bailey

B. Type: Streamlined blades, 19 mm minimum depth, 19 mm maximum spacing, with blades set at 0.79 Rad, vertical or horizontal face as scheduled.

C. Frame: 32 mm margin with countersunk screw mounting.

D. Fabrication: Steel with 1.00 mm minimum frames and 0.90 mm

minimum blades, steel and aluminum with 1.00 mm minimum frame, or aluminum extrusions, with factory off-white enamel finish.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.4 WALL SUPPLY REGISTERS/GRILLES

A. Acceptable Manufacturers:

1. Carnes Co.
2. Krueger Mfg Co.
3. Metalaire
4. Titus Products Div.
5. Tuttle & Bailey

B. Type: Streamlined and individually adjustable blades, 19 mm minimum depth, 19 mm maximum spacing with spring or other device to set blades, vertical or horizontal face, double deflection.

C. Frame: 32 mm margin with countersunk screw mounting and gasket.

D. Fabrication: Steel with 1.00 mm minimum frames and 0.90 mm minimum blades, steel and aluminum with 1.00 mm minimum frame, or aluminum extrusions, with factory off-white enamel finish.

E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.5 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Acceptable Manufacturers:

1. Carnes Co.
2. Krueger Mfg Co.
3. Metalaire

4. Titus Products Div.
5. Tuttle & Bailey

B. Type: Streamlined blades, 19 mm minimum depth, 19 mm maximum spacing, with spring or other device to set blades, vertical or horizontal face.

C. Frame: 32 mm margin with countersunk screw mounting.

D. Fabrication: Steel with 1.00 mm minimum frames and 0.90 mm minimum blades, steel and aluminum with 1.00 mm minimum frame, or aluminum extrusions, with factory off-white enamel finish.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.6 DRUM DIFFUSER

A. Acceptable Manufacturers:

1. Carnes Co.
2. Krueger Mfg Co.
3. Metalaire
4. Titus Products Div.
5. Tuttle & Bailey

B. Type: Streamlined blades, 125 mm maximum spacing, adjustable along axis of drum

C. Frame: 32 mm margin with countersunk screw mounting.

D. Fabrication: Steel with 1.0 mm minimum flanges and 0.9 mm minimum blades. Drum shall rotate 25° both directions within frame. Seal drum to frame by the use of a felt seal. Factory finish in off-white enamel.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09900.

END OF SECTION

SECTION 15951

DIRECT DIGITAL CONTROL FOR HVAC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500	(1989) Test Methods for Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME PTC 19.3	(1974; R 1986) Instruments and Apparatus: Part 3 Temperature Measurement

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 68	Connection of Terminal Equipment to the Telephone Network

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 142	(1991) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Controls and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 555S (1996) Leakage Rated Dampers for Use in Smoke-Control Systems

1.2 GENERAL REQUIREMENTS

The direct digital control (DDC) shall be a complete system suitable for the heating, ventilating and air-conditioning (HVAC) system. The system will, at a future date, be connected to the basewide EMCS. All controlled points, data, setpoints and internal variables shall be available at the EMCS through a dial-up network connection.

1.2.1 Nameplates and Tags

Nameplates bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. Nameplates shall be mechanically attached to Direct Digital Control (DDC) panel interior doors. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

1.2.2 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.2.3 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

1.2.4 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from power-line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

1.2.5 Surge Protection for Transmitter and Control Wiring

DDC system control-panel equipment shall be protected against surges induced on control and transmitter wiring installed for this project. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

a. A 10 microsecond by 1,000 microsecond waveform with a peak voltage of 1,500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1,000 volts and a peak current of 500 amperes.

1.2.6 Power-Line Conditioners (PLC)

PLCs shall be furnished for each DDC panel. The PLCs shall provide both

voltage regulation and noise rejection. The PLCs shall be of the ferro-resonant design, with no moving parts and no tap switching while electrically isolating the secondary from the power-line side. The PLCs shall be sized for 125 percent of the actual connected kVA load. Characteristics of the PLC shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus 1 percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within two cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

1.2.7 System Overall Reliability Requirement

The system shall be configured and installed to yield a mean time between failure (MTBF) of at least 40,000 hours. Each DDC panel shall be designed, configured, installed and programmed to provide for stand alone operation with minimal performance degradation on failure of other system components to which it is connected or with which it communicates.

1.2.8 Multiple DDC Panel Requirement

DDC panels shall be located in the same room as the equipment being controlled or in an adjacent space which has direct access to the equipment room.

1.2.9 System Accuracy and Display

The system shall maintain an end-to-end accuracy for 1 year from sensor to operator's console display for the applications specified and shall display the value as specified. Each temperature shall be displayed and printed to nearest 0.1 degree F.

1.2.9.1 Space Temperature

Space temperature with a range of 50 to 85 degrees F plus or minus 0.75 degree F for conditioned space; 30 to 130 degrees F plus or minus 1 degree F for unconditioned space.

1.2.9.2 Duct Temperature

Duct temperature with a range of 40 to 140 degrees F plus or minus 2 degrees F.

1.2.9.3 Outside Air Temperature

Outside air (OA) temperature with a range of minus 30 to plus 130 degrees F plus or minus 2 degrees F; with a subrange of 30 to 100 degrees F plus or minus 1 degree F.

1.2.9.4 Water Temperature

Water temperature with a range of 30 to 100 degrees F plus or minus 0.75 degree F; the range of 100 to 250 degrees F plus or minus 2 degrees F; and water temperatures for the purpose of performing Btu calculations using differential temperatures to plus or minus 0.5 degrees F using matched sensors.

1.2.9.5 High Temperature

High temperature with a range of 200 to 500 degrees F plus or minus 2.0 degrees F.

1.2.9.6 Relative Humidity

Relative humidity with a range of 20 to 80 percent plus or minus 6.0 percent of range (display and print to nearest 1.0 percent).

1.2.9.7 Pressure

Pressure with a range for the specific application plus or minus 2.0 percent of range (display and print to nearest psi.

1.2.9.8 Flow

Flow with a range for the specific application plus or minus 3.0 percent of range, and flows for the purpose of thermal calculations to plus or minus 2.0 percent of actual flow (display and print to nearest unit, such as gallons per minute).

1.2.9.9 KWh and kW Demand

KWh and kW demand with a range for the specific application plus or minus 1.0 percent of reading (display and print to nearest kWh or kW).

1.2.9.10 Analog Value Input

An analog value input to the system's equipment via an AI with a maximum error of 0.50 percent of range, not including the sensor or transmitter error. This accuracy shall be maintained over the specified environmental conditions.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 15010

Equipment Data

The equipment data shall be in booklet form, indexed to the unique identifiers, shall consist of data sheets that document compliance with the specification and shall include a copy of each HVAC control system bill of materials. Catalog cuts shall be in booklet form indexed by device type. Where multiple components are shown on a catalog cut, the application specific component shall be marked. Data shall include a list of qualified service organizations and their qualifications. Service organizations shall be reasonably convenient to the equipment on a regular and emergency basis, during the warranty period.

System Descriptions and Analyses

System descriptions, analyses, and calculations used in required sizing

equipment. Descriptions and calculations shall show how the equipment will operate as a system to meet the specified performance. The data package shall include the following:

a. DDC panel memory size.

b. DDC panel automatic start up operations.

c. Database update procedure.

d. DDC panel expansion capability and method of implementation.

e. DDC panel operation.

f. Database entry forms or data listings.

Software

Descriptions of software, including the control algorithm for PID control and explanation as required.

Training Data

A training course in the maintenance and operation of the HVAC control systems, approved 60 days prior to the start of training. Lesson plans and training manuals for the training, including type of training to be provided, with a list of reference material. The training shall be oriented to the specific systems being installed. One training manual shall be furnished for each trainee, plus two additional copies for archival storage at the project site. The manuals shall include the agenda, the defined objectives for each lesson, and a detailed description of the subject matter for each lesson. Two copies of audiovisual materials shall be included, for archival storage at the project site, either as a part of the printed training manuals or on the same media as that to be used during the training session.

Data Entry Forms

The completed data entry forms or data summaries, if data entry is done through interactive computer interfacing, utilizing all data required by the contract documents and other pertinent information required for complete installation of the database. Additional data to provide a complete and operational control system shall be identified and requested from the Government. The proposed forms shall be provided at least 90 days prior to the Contractor's scheduled need date.

System Drawings

The system drawings shall include the following:

a. A drawing index.

b. A list of symbols.

c. A series of drawings for each HVAC control system using abbreviations, symbols, nomenclature and identifiers as shown on the contract drawings. Each control-system element on a drawing shall have a unique identifier as shown.

Each series of drawings for an HVAC control system shall include a schematic as shown on the contract drawings, a wiring diagram, a list of equipment with manufacturer and model number, a DDC panel arrangement drawing and an HVAC control-system sequence of operation. The sequence of operation for each HVAC control system shall be in the language and format of this specification. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. The sequence of operation shall refer to each device by its unique identifier.

The wiring diagram shall show the interconnection of wires and cables to DDC panel terminal blocks and to the identified terminals of starters and packaged equipment, with all necessary jumpers and ground connections. The wiring diagram shall show the labels of all conductors. All sources of power required for HVAC control systems and for packaged equipment control systems shall be identified back to the panelboard circuit breaker number, DDC panel, magnetic starter, or packaged control equipment circuit. Each power supply and transformer not integral to a starter or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown.

d. A system block diagram.

e. DDC panel/DTC installation, block diagrams, and wiring diagrams.

f. DDC panel/DTC physical layout and schematics.

g. Details of surge protection device installations.

h. Valve schedules.

The valve schedule shall include each valve's unique identifier, size, flow coefficient (Cv), pressure drop at specified flow rate, spring range, positive-positioner range, and actuator size, supported by close-off pressure data, dimensions, operation rate, and access and clearance requirements data.

i. Damper schedules.

The damper schedule shall contain each damper's and each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive-positioner ranges, locations of actuators and damper end switches, arrangement of sections in multisection dampers, and methods of connecting dampers, actuators, and linkages. The damper schedule shall include the maximum expected velocity through the damper at the intended location and the maximum leakage rate at the operating static-pressure differential. The damper schedule shall contain actuator selection data, supported by calculations of the torque required to move and seal the dampers; and access and clearance requirements.

Commissioning Procedures

Commissioning procedures for each HVAC control system, and for each type of terminal unit control system. The procedures shall reflect the language and format of this specification. The commissioning procedures shall refer to the devices by their unique identifiers as shown and shall include step-by-step configuration procedures for each system. The configuration procedures shall include a configuration check sheet showing all

configuration parameters.

Six copies of Commissioning Procedures, in booklet form and indexed, for each system, 60 days prior to system commissioning. Commissioning procedures shall include general instructions on how to set control parameters including setpoints; proportional, integral, and derivative mode constants; contact output settings for the specific devices provided. Commissioning procedures shall be specific to each HVAC system, shall detail the steps involved, and shall refer to the procedures in the booklet for specific devices.

Control System Calibration, Adjustments, and Commissioning

Six copies of the calibration, adjustment and commissioning report which shall include setpoints and proportional, integral and derivative mode constant settings, calibration data for all instruments and controls, and all the data resulting from adjusting the control system devices and commissioning HVAC control system.

Operation and Maintenance Manuals

The Group III Technical Data Package consisting of the operation and maintenance data in manual format. Final copies of the manuals bound in hardback, loose leaf binders, within 30 days after completing the endurance test. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. Each manual's contents shall be identified on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and of the nearest service representatives for each item of equipment and each system. The draft copy used during site testing shall be updated with any changes required, prior to final submission of the manual. The final copies delivered after completion of the endurance test shall include modifications made during installation checkout and acceptance. Manuals shall include:

Functional Design Manual

Two copies of the functional design manual which shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes.

Hardware Manual

Two copies of the hardware manual which shall describe equipment furnished, including:

a. General description and specifications.

b. Installation and checkout procedures.

c. Equipment electrical schematics and layout drawings.

d. System schematics and I/O device wiring lists.

e. Alignment and calibration procedures.

f. Manufacturer's repair parts list indicating sources of supply.

Software Manual

Two copies of the software manual which shall describe the functions of all software, and shall include all other information necessary to enable proper loading, testing and operation including, but not limited to the following:

a. Definitions of terms and functions.

b. Operator commands.

c. System access requirements.

d. Data entry requirements.

e. Descriptions of application software.

f. Description of database structure and interface with programs.

g. Alarms.

Operator's Manual

Six complete copies of operation manuals for each HVAC control system, in booklet form and indexed, outlining the step-by-step procedures required for each HVAC control system's startup, operation, and shutdown. The manuals shall include all detail drawings, equipment data, and manufacturer supplied operation manuals for all equipment.

Maintenance Manual

Six complete copies of maintenance manuals, indexed in booklet form listing maintenance procedures. The maintenance instructions shall include a maintenance check list for each HVAC control system. Maintenance manuals shall include spare parts data and recommended maintenance tool kits for all control devices. Maintenance instructions shall include recommended repair methods, either field repair, factory repair, or whole-item replacement. The manual shall contain a list of service organizations qualified to service the HVAC control system, including the service organization name and telephone number. If operation and maintenance manuals are provided in a common volume, they shall be clearly differentiated and separately indexed.

1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage-condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

1.5 TESTING

1.5.1 NOT USED

1.5.2 Site Testing

Personnel, equipment, instrumentation, and supplies shall be provided as necessary to perform site testing, adjusting, calibration and commissioning. The tests shall not be conducted during scheduled seasonal off periods of base heating and cooling systems. Wiring shall be tested for continuity and for ground, open, and short circuits. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. Written Government approval of the specific site testing procedures shall be obtained prior to any test. Written notification of any planned site testing, commissioning or tuning shall be given at least 14 calendar days prior to any test.

1.5.3 Control System Calibration, Adjustments, and Commissioning

Instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Mechanical control devices shall be adjusted to operate as specified. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated. Control system commissioning shall be performed for each HVAC system. The report describing results of functional tests, diagnostics, and calibrations, including written certification, shall state that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

1.5.4 Performance Verification Test

Compliance of the HVAC control system with the contract documents shall be demonstrated. Using test plans and procedures previously approved, physical and functional requirements of the project, including communication requirements shall be demonstrated. The performance verification test procedures shall explain, step-by-step, the actions and expected results that will demonstrate that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt of written permission by the Government, based on the Contractor's written certification of successful completion of site testing and training.

1.5.5 Endurance Test

The endurance test shall be used to demonstrate the specified overall system reliability requirement of the completed system. The endurance test shall not be started until the Government notifies the Contractor in writing that the performance verification test is satisfactorily completed. The Government may terminate the testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

a. Phase I (Testing)

The test shall be conducted 24 hours per day, 7 days per week, for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

b. Phase II (Assessment)

After the conclusion of Phase I, the Contractor shall identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and test review meeting, the Government may require that the Phase I test be totally or partially rerun. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

1.5.6 Coordination with HVAC System Balancing

The HVAC control system shall be tuned after all air-system and hydronic-system balancing has been completed, minimum damper positions set and a report issued. Commissioning may be performed prior to or simultaneous with HVAC system balancing.

1.5.7 Posted Instructions

Instructions on letter-size sheets and half-size plastic laminated drawings for each system, showing the final installed conditions, shall be placed in each HVAC control panel. The posted instructions shall include the control sequence, control schematic, ladder diagram, wiring diagram, valve schedules, damper schedules, commissioning procedures, and preventive maintenance instructions.

1.6 TRAINING

1.6.1 General

The training course shall be conducted for 6 operating staff members designated by the Contracting Officer in the maintenance and operation of the system, including specified hardware and software. A training day is defined as 8 hours of classroom instruction, including breaks and lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance in planning the required instruction, the Contractor shall assume that the attendees will have a high school education or equivalent, and are familiar with HVAC systems. No training shall be scheduled until training manuals and O&M manuals have been approved by the Government.

1.6.2 Training Course Content

The course shall be taught at the project site for a period of 2 training days. The training course shall cover all the material contained in the Operating and Maintenance Instructions, the layout and location of each HVAC control panel, the layout of one of each type of unitary equipment and the locations of each, the location of each system-control device external to the panels, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the

performance verification test and the calibration, adjustment and commissioning report shall be presented as benchmarks of HVAC control-system performance by which to measure operation and maintenance effectiveness.

1.7 MAINTENANCE AND SERVICE

1.7.1 General Requirements

Services, materials and equipment shall be provided as necessary to maintain the entire system in an operational state as specified for a period of 1 year after successful completion and acceptance of the Performance Verification Test. Impacts on facility operations shall be minimized.

1.7.2 Description of Work

The adjustment and repair of the system shall include the manufacturer's required adjustments of computer equipment, software updates, transmission equipment and instrumentation and control devices.

1.7.3 Personnel

Service personnel shall be qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

1.7.4 Scheduled Inspections

Two inspections shall be performed at 6 month intervals (or less if required by the manufacturer), and all work required shall be performed. Inspections shall be scheduled in June and December. These inspections shall include:

a. Visual checks and operational tests of all equipment.

b. Fan checks and filter changes for all control system equipment.

c. Clean all control system equipment including interior and exterior surfaces.

d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog points during the first inspection. Check and calibrate the remaining 50 percent of the analog points during the second major inspection. Certify analog test instrumentation accuracy to be twice that of the device being calibrated. Randomly check at least 25 percent of all digital points for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital points during the second inspection.

e. Run all system software diagnostics and correct all diagnosed problems.

f. Resolve any previous outstanding problems.

1.7.5 Scheduled Work

This work shall be performed during regular working hours, Monday through

Friday, excluding legal holidays.

1.7.6 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition within 3 calendar days after receiving a request for service.

1.7.7 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the performance verification test.

1.7.8 Records and Logs

Dated records and logs shall be kept of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain all initial analog span and zero calibration values and all digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

1.7.9 Work Requests

Each service call request shall be recorded as received and shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. A record of the work performed shall be submitted within 5 days after work is accomplished.

1.7.10 System Modifications

Recommendations for system modification shall be submitted in writing. System modifications, including operating parameters and control settings, shall not be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.7.11 Software

Software shall be provided which enables full access to control parameters and logic. Updates to the software shall be provided for system; operating and application software shall be updated and operation in the system shall be verified. Updates shall be incorporated into operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the latest released version of the Contractor's software shall be installed and validated.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

Units of the same type of equipment shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in a satisfactory commercial or industrial use for 2 years prior to use on this project. The 2 years use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. Items of the same type and purpose shall be identical, including equipment, assemblies, parts and components. Automatic temperature controls shall be direct digital controls that will provide the required sequence of operation. No pneumatics will be allowed.

2.1.1 Electrical and Electronic Devices

Electrical and electronic devices not located within an HVAC control panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown.

2.1.2 Standard Signals

Except for air distribution terminal unit control equipment, the output of all analog transmitters and the analog input and output of all DDC panels shall be 4-to-20 mAdc signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

2.1.3 Ambient Temperature Limits

DDC panels shall have ambient condition ratings of plus 35 to 120 degrees F and 10 to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 35 to 150 degrees F. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

2.2 NOT USED

2.3 WIRING

2.3.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

2.3.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum and shall be rated for 300-volt service.

2.3.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 14 AWG minimum and shall be rated for 600-volt service.

2.3.4 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single- or multiple-twisted, minimum 51 mm lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.4 ACTUATORS

2.4.1 General Requirements

Actuators shall be electric or electronic as shown. Actuators shall fail to their spring-return positions on signal or power failure and shall have a visible position indicator. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale input signal change. Electric or electronic actuators operating in parallel or in sequence shall have an auxiliary actuator driver.

2.4.2 Damper Actuators

The actuators shall be provided with mounting and connecting hardware. Actuators shall smoothly operate the devices to which they are applied. Actuators shall fully open and close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. The actuator stroke shall be limited by an adjustable stop in the direction of power stroke.

2.4.3 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

2.5 AUTOMATIC CONTROL VALVES

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Unless otherwise specified, bodies for valves 40 mm and smaller shall be brass or bronze, with threaded or union ends; bodies for 50 mm valves shall have threaded ends; and bodies for valves 50 to 80 mm shall be of brass, bronze or iron. Bodies for valves 65 mm and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 to 125 percent of the Cv shown.

2.5.1 Butterfly-Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from 20 to 250 degrees F. Valves shall have a manual means of operation independent of the actuator.

2.5.2 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

2.5.3 Three-Way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

2.5.4 NOT USED

2.5.5 Valves for Chilled Water and Glycol Service

Internal valve trim shall be bronze except that valve stems may be type 316 stainless steel. Valve Cv shall be within 100 to 125 percent of the Cv shown. Valves 100 mm and larger shall be butterfly.

2.5.6 Valves for Hot Water Service

Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 100 mm and larger shall be butterfly valves.

2.6 DAMPERS

2.6.1 Damper Assembly

A single damper section shall have blades no longer than 1.2 meters and shall be no higher than 1.8 meters. Maximum damper blade width shall be 203 mm. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream. Damper axles shall be 13 mm minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 10 Pa at 5.1 m/s in the wide-open position. Frames shall not be less than 50 mm in width. Dampers shall be tested in accordance with AMCA 500.

2.6.2 Operating Links

Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of

dampers.

2.6.3 Damper Types

2.6.3.1 Outside Air, Return Air, and Relief Air Dampers

Outside air, return air and relief air dampers shall be provided where shown and be of the opposed blade type. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 102 L/s per square meter at 1017 Pa static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees C to 94 degrees C. Dampers shall be rated at not less than 10 m/s air velocity.

2.6.3.2 Mechanical and Electrical Space Ventilation Dampers

Mechanical and electrical space ventilation dampers shall be as shown and be of the parallel blade type. Dampers shall not leak in excess of 406 L/s per square meter at 1017 Pa static pressure when closed. Dampers shall be rated at not less than 7.6 m/s air velocity.

2.6.3.3 Smoke Dampers

Smoke damper and actuator assembly required per NFPA 90A shall meet the Class II leakage requirements of UL 555S. Dampers shall be rated at not less than 10 m/s air velocity.

2.6.4 Damper End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

2.7 SMOKE DETECTORS

Smoke detectors shall be as specified in Section 16721 FIRE DETECTION AND ALARM SYSTEM.

2.8 INSTRUMENTATION

2.8.1 Measurements

Each transmitter shall have offset and span adjustments. Transmitters shall be calibrated to provide the following measurements, over the indicated ranges, for a linear output of 4-to-20 mAdc:

a. Conditioned space temperature, from 50 to 85 degrees F.

b. Duct temperature, from 40 to 140 degrees F except that return air temperature for economizer operation shall be minus 30 to plus 130 degrees F.

c. Chilled water temperature, from 30 to 100 degrees F.

d. Heating hot water temperature, from 100 to 250 degrees F.

e. Outside air temperature, from minus 30 to plus 130 degrees F.

f. Relative humidity, 0 to 100 percent for high limit applications; from 20 to 80 percent for space applications.

g. Pitot tube air flow measurement station and transmitter, from 0 to 0.1 inch water gauge for flow velocities of 500 to 1,200 fpm; 0 to 0.25 inch water gauge for velocities of 500 to 1,800 fpm; or 0 to 0.5 inch water gauge for velocities of 500 to 2,500 fpm.

2.8.2 Temperature Instruments

2.8.2.1 Resistance Temperature Detectors (RTD)

Each RTD shall be platinum with a tolerance of plus or minus 0.1 percent at 32 degrees F, and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally mounted unless otherwise shown.

2.8.2.2 Continuous Averaging RTD

Continuous averaging RTDs shall have a tolerance of plus or minus 1.0 degree F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. The sensing element shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter to match the resistance range of the averaging RTD.

2.8.2.3 RTD Transmitter

The RTD transmitter shall match the resistance range of the RTD. The transmitter shall be a 2-wire, loop powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated measurement.

2.8.3 Relative Humidity Instruments

Relative humidity sensing element shall have a relative humidity sensing range from 0-100 percent (condensing). The sensor shall be capable of, sensing a condensing air stream (100 percent RH) without affect to the sensors calibration or harm to the sensor. The sensor shall be wall mount type or duct mount type as appropriate and shall be provided with the required accessories. Duct sensors shall be provided with duct probe designed to protect the sensing element from dust accumulation and mechanical damage. Sensing elements shall have an accuracy of plus or minus 5 percent of full scale within the range of 20 to 80 percent relative humidity. A 2-wire, loop powered transmitter located at the sensing element shall be provided to convert the sensing element output to a linear 4-to-20 mAdc output corresponding to the required humidity measurement. The output error shall not exceed 0.1 percent of calibrated measurement.

2.8.4 NOT USED

2.8.5 NOT USED

2.8.6 Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing

element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus 2 percent of full scale. The transmitter shall be a 2-wire, loop powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required pressure measurement.

2.8.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 50 mm lagging neck and extension type well. Inside diameter and insertion length shall be as required for the application.

2.8.8 Sunshields

Sunshields for outside air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The top of each sunshield shall have a galvanized metal rainshield projecting over the face of the sunshield. The sunshields shall be painted white.

2.9 THERMOSTATS

2.9.1 General

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electric or low-voltage electronic.

2.9.2 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 5 degrees F. Room thermostats shall be enclosed with separate locking covers (guards).

2.9.3 NOT USED

2.9.4 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 4 to 8 degrees F for each output. Room thermostats shall be enclosed with separate locking covers (guards).

2.9.5 NOT USED

2.9.6 Freezestats

Freezestats shall be manual reset, low temperature safety thermostats, with NO and NC contacts and a 20 foot element which shall respond to the coldest 18 inch segment.

2.10 PRESSURE SWITCHES AND SOLENOID VALVES

2.10.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40

percent of the range of the device.

2.10.2 Differential Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. Range shall be 5.0 to 6.0 inches water gauge. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

2.11 INDICATING DEVICES

2.11.1 Insertion Thermometers

Thermometers for insertion in ductwork and piping systems shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 230 mm scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern, and shall conform to ASME PTC 19.3.

2.11.2 Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.11.3 Air Duct Thermometers

Air duct thermometers shall have perforated stem guards and 45 degree adjustable duct flanges with locking mechanism.

2.11.4 Averaging Thermometers

Averaging thermometers shall have 90 mm (nominal) dial, with black legend on white background, and pointer traveling through a 270 degree arc.

2.11.5 Accuracy

Thermometers shall have an accuracy of plus or minus 1 percent of scale range. Thermometers shall have the following ranges:

a. Mixed air, return air, cooling-coil discharge, and glycol cooling temperatures: 0 to 100 degrees F in 1 degree graduations.

b. Heating-coil discharge temperature: 30 to 180 degrees F in 2 degree graduations.

c. Hydronic heating systems below 220 degrees F: 40 to 240 degrees F in 2 degree graduations.

2.11.6 Pressure Gauges

Gauges shall be 50 mm (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270 degree arc. Accuracy shall be plus or minus 3 percent of scale range. Gauges shall meet

requirements of ASME B40.1.

2.12 RELAYS

Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts (two normally open, two normally closed) enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage. Time delay relays shall be 2 PDT with 8-pin connectors, dust cover, and a matching rail mounted socket. Adjustable timing range shall be 0 to 3 minutes. Power consumption shall not be greater than 3 watts.

2.13 NOT USED

2.14 WATTHOUR METERS

Watthour meters shall be in accordance with ANSI C12.1 and shall have pulse initiators for remote monitoring of watthour consumption. Pulse initiators shall consist of contacts (one normally open, one normally closed) with a current rating not to exceed 2 amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Pulse initiator contacts shall be connected to a terminal strip external to the meter enclosure. Meter sockets shall be in accordance with ANSI C12.1.

2.15 WATTHOUR TRANSDUCERS

Watthour transducers shall have an accuracy of plus or minus 0.25 percent of full scale for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh transducers shall be selectable without requiring the changing of current or potential transformers. The output shall be 4-to-20 mAdc.

2.16 NOT USED

2.17 FIELD HARDWARE

2.17.1 Direct Digital Control (DDC) Panel Hardware

DDC panels shall be microcomputer based with sufficient memory to perform specified DDC panel functions and operations. The panel shall not be dependent on logic or data from an external computer. The panel shall contain necessary I/O functions to connect to field sensors and control devices. The DDC panel shall include:

a. Main power switch.

b. Power on indicator.

c. Portable tester connector.

d. On-Off-Auto switches for each digital output. The status of these switches will be available to the DDC panel for further processing.

e. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual potentiometer, for each analog output. The status of these switches will be available to the DDC panel for further processing.

2.17.1.1 Sealed Battery Backup

A sealed battery backup for the DDC panel memory and real time clock function sufficient to maintain them for a minimum period of 8 hours shall be provided. Automatic charging of batteries shall be provided, or alternately, lithium batteries sized to provide a minimum of 30 days operation and a shelf life of 2 years shall be provided. A low battery alarm with indication for each DDC panel shall be provided. Alternatively, capacitors may be provided to maintain memory and clock function for a minimum of 8 hours.

2.17.1.2 Electrical Service Outlet for use with Test Equipment

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 2 m of the DDC panel enclosure.

2.17.1.3 Locking Type Mounting Cabinets

Locking type mounting cabinets, with common keying and door switch wired to and DDC panel input for intrusion alarm annunciation, shall be furnished.

2.17.1.4 Failure Mode

Upon failure of the DDC panel, all connected points shall be forced to the failure mode shown in the I/O summary tables.

2.17.1.5 Portable Tester

Provisions for connection of a portable tester shall be furnished at each DDC panel location.

2.17.1.6 I/O Functions

I/O functions shall be provided as part of the DDC panel and shall be in accordance with the following:

a. The Analog Input (AI) function shall monitor each analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. The A-to-D conversion shall have a minimum resolution of 10 bits plus sign. Signal conditioning shall be provided for each analog input. Analog inputs shall be individually calibrated for zero and span, in hardware or in software. The AI shall incorporate common mode noise rejection of 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of 20 dB at 60 Hz from a source impedance of 10,000 ohms. Input ranges shall be within the range of 4-to-20 mAdc.

b. The Analog Output (AO) function shall accept digital data, perform D-to-A conversion, and output a signal within the range of 4-to-20 mAdc. D-to-A conversion shall have a minimum resolution of 8 bits plus sign. Analog outputs shall be individually calibrated for zero and span. Short circuit protection on voltage outputs and open circuit protection on current outputs shall be provided. An individual gradual switch for manual override of each analog output and means of physically securing access to these switches shall be provided. Each AO shall have a three-position switch for selection of the DDC control signal, no control, or a locally generated

control signal for connection to the controlled device. Feedback shall be provided to the system as to the status of the output (manual control or automatic). Switches for pneumatic control outputs shall provide a connection for an externally generated pneumatic signal. All switches shall be either of a key operated design with the same keying system used for other outputs or otherwise suitably protected from unauthorized access.

c. The Digital Input (DI) function shall accept on-off, open-close, or other change of state (two state data) indications. Isolation and protection against an applied steady-state voltage up to 180 Vac peak shall be provided.

d. The Digital Output (DO) function shall provide contact closures for momentary and maintained operation of output devices. Closures shall have a minimum duration of 0.1 second. DO relays shall have an initial breakdown voltage between contacts and coil of at least 500 V peak. Electromagnetic interference suppression shall be furnished on all output lines to limit transients to nondamaging levels. Protection against an applied steady-state voltage up to 180 Vac peak shall be provided. Minimum contact rating shall be 1 ampere at 24 Vac. Key locked HOA switches shall be provided for manual override of each digital output. Feedback shall be provided to the system as to the status of the output (manual control or automatic). All switches shall be common keyed.

e. The pulse accumulator function shall have the same characteristics as the DI. In addition, a buffer shall be provided to totalize pulses and allow for interrogation by the DDC panel. The pulse accumulator shall accept rates up to 20 pulses per second. The totalized value shall be reset to zero upon operator's command.

f. Signal conditioning for sensors shall be provided as specified.

2.17.2 NOT USED

2.17.3 Command Entry Device

A command entry device shall be provided for use with DDC panels. The command entry device shall consist of a laptop computer. Microprocessor shall be minimum 300 MHz Pentium Processor. Storage shall consist of minimum 64 megabytes RAM and 4.0 Gigabyte fixed disc storage. Equip with 3 1/2" floppy and 24 x CD Rom Drive. Display shall be active matrix type with minimum 1024 x 768 pixel resolution. Minimum modem speed shall be 33,600 bps. Laptop shall include integrated mouse pointing device. A printer shall also be provided. The command entry device shall be provided with communications interfaces to each DDC panel, and shall:

a. Allow for entry of database information, including parameters and constraints from the keyboard.

b. Display any digital, analog, and pulse accumulator input.

c. Control any digital and analog output.

d. Provide operator interface in alphanumeric and decimal.

e. Disable/enable any DDC panel.

2.17.3.1 Communications

A port and proper cabling shall be provided to allow for communications between the command entry device and the DDC panel.

2.17.3.2 NOT USED

2.17.3.3 Printer

A printer shall be provided for use with the command entry device. Minimum configuration shall consist of 600 x 600 dpi color inkjet printer equipped with both a black and a color ink cartridge. Unit shall accept standard single sheet letter size paper. Resolution shall be software selectable through the command entry device.

2.17.3.4 Hard Disk

The device shall allow each DDC panel database to be stored as a separate file.

2.17.4 DDC Panel Portable Tester

Either as part of the command entry device or as a separate portable device capable of connection to any DDC panel, a portable test device shall be provided which includes a keyboard, display, and mass storage sufficient to perform, as a minimum, the following functions through the portable tester:

a. Load all DDC panel software and information, including parameters and constraints.

b. Display the status or value of all points connected to the DDC panel.

c. Control the outputs connected to the DDC panel.

d. Perform DDC panel diagnostic testing.

e. Provide operator interface in alphanumerics and decimal (hexadecimal, octal, and binary display shall not be utilized).

f. Accept DDC panel software and information from the command entry device panel for subsequent loading into a specific DDC panel. Provide all necessary software and hardware required to support this function.

2.17.5 NOT USED

2.17.6 Communication Equipment

The DDC panel shall be equipped with hardware to allow for communication over Data Transmission Media (DTM) using the communication network as shown.

2.17.7 Dial Up Modem

A type V.32 Modem operating at 1,200 or 2,400 BPS with automatic/selectable fall back operation with automatic answer and automatic dial capability shall be connected to the control system and to the telephone system and shall be certified to meet the requirements of 47 CFR 68.

2.18 DIRECT DIGITAL CONTROL PANEL SOFTWARE

Each DDC panel, shall contain an operating system that controls and schedules that DDC panel's activities in real time. The DDC panel shall maintain a point database in its RAM that includes all parameters, constraints, and the latest value or status of all points connected to that DDC panel. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. The operating system shall allow local loading of software and data files from the portable tester and from an operator interface panel.

2.18.1 Command Priorities

A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the on and off states, ensuring that the correct command will be issued when the time constraint is no longer in effect or report the rejected command. Override command entered by the operator shall have higher priority than those emanating from application programs.

2.18.2 DDC Panel Startup

The DDC panel shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions. A DDC panel restart program based on detection of power failure at the DDC panel shall be included in the DDC panel software. Upon restoration of power to the DDC panel, the program shall restart all equipment and restore all loads to the state at time of power failure, or to the state as commanded by time programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the DDC panel and if the database and application software are no longer resident, or if the clock cannot be read, the DDC panel shall not restart and systems shall remain in the failure mode until the necessary repairs are made. If the database and application programs are resident, the DDC panel shall resume operation after an adjustable time delay of from 0 to 600 seconds. The startup sequence for each DDC panel shall include a unique time delay setting when system operation is initiated.

2.18.3 DDC Panel Operating Mode

Each DDC panel shall control and monitor all functions independent of communication with any other source. The software shall perform DDC panel functions and DDC panel resident application programs using data obtained from I/O functions and based upon the DDC panel real time clock function. The DDC panel software shall execute commands after performing constraint checks in the DDC panel.

2.18.4 DDC Panel Failure Mode

Upon failure for any reason, the system shall perform an orderly shutdown and force all DDC panel outputs to a predetermined state, consistent with the failure modes defined in the I/O summary tables and the associated controlled devices.

2.18.5 DDC Panel Functions

Software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within the DDC panel shall be provided:

a. Scanning of inputs.

b. Control of outputs.

c. Store alarms for reporting when requested.

d. Maintain real time.

e. Execute DDC panel resident application programs.

f. Averaging or filtering of each analog input.

g. Constraint checks, prior to command issuance.

h. DDC panel diagnostics.

i. DDC panel portable tester operation.

2.18.6 Analog Monitoring

The DDC panel shall measure analog values and shall be capable of transmitting analog values for display. An analog change in value is defined as a change exceeding a preset differential value as specified. Displays and reports shall express analog values in proper engineering units with polarity sign. The system shall accommodate up to 255 different sets of engineering unit conversions. Each engineering unit conversion shall include range, span, and conversion equation.

2.18.7 Logic (Virtual) Points

Logic (virtual) points shall be software points entered in the point database which are not directly associated with a physical I/O function. This value shall be created by calculating it from any combination of digital and analog points, or other data. Logic points shall be analog or digital points having all the properties of real points, including alarms, without the associated hardware. Logic points shall be defined or calculated and entered into the database by the Contractor as required. The calculated analog point shall have point identification in the same format as any other analog point. The calculated point shall be used in any program where the real value is not obtainable directly. Calculated point values shall be current for use by the system within 30 seconds of the time any input value changes and shall include:

a. Control loop setpoints.

b. Control loop gain constants.

c. Control loop integral constants.

d. Summer/winter operation.

e. Real time.

f. Scheduled on/off times.

g. Equipment run-time targets.

h. Calculated point values.

2.18.8 I/O Point Definition

Each I/O point shall be defined in a database in the DDC panel. The definition shall include all physical parameters and constraints associated with each point.

2.18.9 Parameter Definition

Each I/O point shall be defined and entered into the database by the Contractor, including as applicable:

a. Name.

b. Device or sensor type (i.e., sensor, control, motors).

c. Point identifications number.

d. Area.

e. Sensor range.

f. Controller range.

g. Sensor span.

h. Controller span.

i. Engineering units conversion (scale factor).

j. High and low reasonableness value (analog).

k. High and low alarm limit (analog).

l. High and low alarm limit differential (return to normal).

m. Analog change differential (for reporting).

n. High accumulator limit (pulse).

o. Status description (digital inputs).

2.18.10 Alarm Processing

Each DDC panel shall have alarm processing software for digital, analog, and pulse accumulator alarms for all input and virtual points connected to that DDC panel.

2.18.10.1 Digital Alarms Definition

Digital alarms are those abnormal conditions indicated by digital inputs as specified in the I/O Summary Tables and elsewhere.

2.18.10.2 Analog Alarms Definition

Analog alarms are those conditions higher or lower than a defined value, as measured by an analog input as specified in the I/O Summary Tables and elsewhere. Analog readings shall be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits shall be assigned to each analog point in the system. Analog alarm limits shall be stored in the DDC panel database. Each analog alarm limit shall have an associated unique limit differential specifying the amount by which a variable must return to the proper operating range before being declared as a return-to-normal state. Limits and differentials shall be entered on line by the operator in limits or the measured variable, without interruption or loss of monitoring of the point concerned.

2.18.10.3 Pulse Accumulator Alarms Definition

Pulse accumulator alarms are those conditions calculated from totalized values of accumulator inputs or pulse accumulator inputs rates that are outside defined limits as specified in the I/O Summary Tables and elsewhere. Pulse accumulator totalized values shall be compared to predefined limits and alarmed each time a value enters a limit condition. Unique limits shall be assigned to each pulse accumulator point in the system. Limits shall be stored in the DDC panel database.

2.18.10.4 Equipment Constraints Definitions

Each control point in the database shall have DDC panel resident constraints defined and entered by the Contractor, including as applicable:

a. Minimum off time.

b. Minimum on time.

c. High limit (value in engineering units).

d. Low limit (value in engineering units).

2.18.10.5 Constraint Checks

Control devices connected to the system shall have the DDC panel memory resident constraints checked before each command is issued to ensure that no equipment damage will result from improper operation. Each command shall be executed by the DDC panel only after all constraint checks have been passed. Each command point shall have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value shall be assigned to each analog input. Values outside the reasonableness limits shall be rejected and an alarm generated. Status changes and analog point values shall be reported upon request, such as for reports, and application programs. Each individual point shall be capable of being selectively disabled by the operator. Disabling a point shall prohibit monitoring and automatic control of that point.

2.18.11 DDC Panel Diagnostics

Each DDC panel shall have self-test diagnostic routines implemented in firmware. The tests shall include routines that exercise memory. Diagnostic software shall be provided for use in the portable tester. The software shall display messages in plain language to inform the tester's operator of diagnosed problems.

2.18.12 Summer/Winter Operation Monitoring

The system shall provide software to change the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system where such a change from summer to winter and vice versa is meaningful. The software shall provide commands to application programs to coordinate summer or winter operation.

2.18.13 Control Sequences and Control Loops

Operator commands shall be used to create and execute control sequences and control loops for automated control of equipment based on operational parameters including times and events, defined in the database. Through the command entry device, the system shall prompt the operator for information necessary to create, modify, list, and delete control sequences and Proportional-plus-Integral-plus Derivative (PID) control loops. The system shall prompt the operator for confirmation that the control sequence and control loop addition/modification/deletion is correct, prior to placing it in operation. Mathematic functions required shall be available for use in creating the control sequences and control loops. Sufficient spare memory shall be provided to allow four control sequences and four control loops in addition to those necessary to implement the requirements specified for each DDC panel. Each control sequence shall accommodate up to eight terms or devices.

2.18.13.1 Control Functions

The DDC panel shall provide the following control functions:

a. PID Control

The system shall provide for PID control. The control algorithm intended for use shall be submitted for approval with a full explanation of its functions and limitations. A determination shall be made of the antiwindup limit for the DDC panel software (for example, an antiwindup limit of plus/minus one half of the actuator range).

b. Two Position Control

This function shall provide control for two state device control by comparing a setpoint against a process variable and an established deadband.

c. Floating Point Control

This function shall exercise control when an error signal exceeds a selected deadband, and shall maintain control until the error is within the deadband limits.

d. Signal Selection

This function shall allow the selection of the highest or lowest analog value from a group of analog values as the basis of control. The function shall include the ability to cascade analog values so that large numbers of inputs, up to a maximum of 20, can be reduced to one or two outputs.

e. Reset Function

This function shall develop an analog output based on up to two analog

inputs and one operator specified reset schedule.

f. Self Tuning

The controller shall provide self tuning operation to proportional, integral and derivative modes of control and shall modify the mode constants as required.

2.18.13.2 DDC Panel Resident Applications Software

Application software required to achieve the sequences of operation, parameters, constraints, and interlocks necessary to provide control of the systems connected to the DDC system shall be provided. Application software shall be resident and executing in the DDC panel, and shall be coordinated to ensure that no conflicts or contentions remain unresolved.

The following Optimum Start/Stop Program software shall be provided in addition to that required elsewhere:

HVAC equipment which is required to be started and stopped based on a time schedule shall be subject to this program. The program shall take into account the thermal characteristics of the structure, indoor and outdoor air conditions using prediction software to determine the minimum time of HVAC system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end without allowing the space environmental conditions to drift out of the range specified for the occupied cycle before the start of the unoccupied cycle.

2.18.14 Communication Programs

The DDC panels shall be equipped with software drivers and handlers which allow for communication with a base-wide EMCS/UMCS. The software drivers shall allow for communications via modems, line drivers, transmitters/receivers over LAN, wirelines, fiber optic or coaxial cables. The software shall be structured to support communication over a network with star, ring, radial, or a combination of topologies. Each communication program module shall be functionally independent of other Contractor-furnished software, to allow for future upgrade or replacement of communication modules without affecting other application programs and other software modules. Communication protocol for communication shall conform to a standard communication protocol.

2.19 WIRE AND CABLE

2.19.1 Digital Functions

Control wiring for digital functions shall be 18 AWG minimum with 600-volt insulation. Multiconductor wire shall have an outer jacket of polyvinyl chloride (PVC).

2.19.2 Analog Functions

Control wiring for analog functions shall be 18 AWG minimum with 600-volt insulation, twisted and shielded, 2-, 3-, or 4-wire to match analog function hardware. Multiconductor wire shall have an outer jacket of PVC.

2.19.3 Sensor Wiring

Sensor wiring shall be 20 AWG minimum twisted and shielded, two-, three-, or four-wire to match analog function hardware. Multiconductor wire shall have an outer jacket of PVC.

2.19.4 Class 2 Low Energy Conductors

The conductor sizes specified for digital and analog functions shall take precedence over any requirements for Class 2 low energy remote-controlled and signal-circuit conductors specified elsewhere.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION CRITERIA

3.1.1 HVAC Control System

The HVAC control system shall be completely installed and ready for operation. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Software Installation

Software shall be loaded for an operational system, including databases for all points, operational parameters, and system, command, and application software. The Contractor shall provide original and backup copies of all source software provided with hardware, and object modules for all software on each type of media utilized, within 30 days of formal Government acceptance. In addition, a copy of individual floppy disks of all software for each DDC panel shall be provided.

3.1.3 Device-Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with all required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

3.1.4 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and DDC panels. Instrumentation grounding shall be installed as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings, in accordance with the requirements of Section 16123 ELECTRICAL WORK, INTERIOR. Other electrical work shall be as specified in Division 16.

3.2 CONTROL-SYSTEM INSTALLATION

3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

3.2.2 NOT USED

3.2.3 Room-Instrument Mounting

Room instruments shall be mounted so that their sensing elements are 1.5 m above the finished floor unless otherwise shown. Temperature setpoint device shall be recess mounted.

3.2.4 Freezestats

For each 2 square meters of coil-face area, or fraction thereof, a freezestat shall be provided to sense the temperature at the location shown. Manual reset freezestats shall be installed in approved, accessible locations where they can be reset easily. The freezestat sensing element shall be installed in a serpentine pattern.

3.2.5 Averaging-Temperature Sensing Elements

Sensing elements shall have a total element minimum length equal to 3 m per square meter of duct cross-sectional area.

3.2.6 NOT USED

3.2.7 NOT USED

3.2.8 NOT USED

3.2.9 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

3.3 NOT USED

3.4 COMMISSIONING PROCEDURES

3.4.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, set the time schedule, and make any necessary control-system corrections to ensure that the systems function as described in the sequence of operation.

3.4.1.1 Item Check

Signal levels shall be recorded for the extreme positions of each controlled device. An item-by-item check of the sequence of operation requirement shall be performed using Steps 1 through 4 in the specified

control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shut down; Step 4 shall be performed after the HVAC systems have been started. External input signals to the DDC panel (such as starter auxiliary contacts, and external systems) may be simulated in steps 1, 2, and 3. With each operational-mode signal change, DDC panel output relay contacts shall be observed to ensure that they function.

3.4.1.2 Weather-Dependent Test Procedures

Weather-dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

3.4.1.3 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the DDC panel readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-DDC panel readout accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC panel readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

3.4.1.4 Insertion and Immersion Temperatures

Insertion temperature and immersion temperature sensing elements and transmitter-to-DDC panel readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

3.4.1.5 Averaging Temperature

Averaging-temperature sensing element and transmitter-to-DDC panel readout calibration accuracy shall be checked every 600 mm along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

3.4.2 NOT USED

3.4.3 Unit Heater

The "OFF/AUTO" switch shall be placed in the "OFF" position. Each space-thermostat temperature setting shall be turned up so that it makes contact and turns on the unit heater fans. The unit heater fans shall not start. The "OFF/AUTO" switch shall be placed in the "AUTO" position. It shall be ensured that the unit-heater fans start. Each space thermostat temperature setting shall be turned down, and the unit-heater fans shall stop. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.4 Gas-Fired Infrared Heater

Each space thermostat temperature setting shall be turned up so that it makes contact to turn on the infrared heater; it shall be ensured that the heater turns on. Each space-thermostat temperature shall be turned down and it shall be ensured that the infrared heater turns off. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.5 NOT USED

3.4.6 NOT USED

3.4.7 NOT USED

3.4.8 Chiller

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. It shall be verified that power is available where required.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature-sensing element location. Each temperature shall be read at the DDC panel, and the thermometer and DDC panel readings logged. The calibration accuracy of the sensing element-to-DDC panel readout for outside air temperature and system supply temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC panel. The proper operation of the actuators and positioners for all valves shall be verified visually. The signal shall be varied from live zero to full range, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control-System Commissioning:

(1) The two-point calibration sensing element-to-DDC panel readout accuracy check for the outside air temperature shall be performed. Any necessary software adjustments to setpoints or parameters shall be made to achieve the outside air temperature schedule.

(2) The outside air temperature shall be simulated through an operator entered value to be below the setpoint. It shall be verified that pumps and chiller stop. A value shall be entered to simulate that the outside air temperature is above the setpoint as shown. It shall be verified that pumps start and chiller operates.

3.4.9 NOT USED

3.4.10 NOT USED

3.4.11 NOT USED

3.4.12 NOT USED

3.4.13 Heating and Ventilating

Steps for installation are as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. The system shall be checked to see that power is available where required, the outside air damper is closed, and the return air damper is open.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature- sensing element location. Each temperature shall be read at the DDC panel, and the thermometer and DDC panel readings logged. The calibration accuracy of the sensing element-to-DDC panel readout for space temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value at the DDC panel. The proper operation of the actuators and positioners for all dampers and valves shall be verified. The signal shall be varied from live zero to full range, and that the actuators travel from zero stroke to full stroke within the signal range shall be verified. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control-System Commissioning:

(1) With the fan ready to start, the system shall be placed in the ventilation-delay mode and in the occupied mode through operator entered values. It shall be verified that supply fan starts. It shall be verified that the outside air damper is closed, the return air damper is open, and the burner is under control, by artificially changing the space temperature through operator entered values. The system shall be placed out of the ventilation-delay-mode, and it shall be verified that the outside air, return air, dampers toggle by simulating a change in space temperature.

(2) The calibration accuracy check for sensing element-to-DDC panel readout for the space temperature shall be performed. The space temperature setpoint shall be set for 70 degrees F at midpoint, 55 degrees F at the low end, and 85 degrees F at the high end. Proper operation of the temperature setpoint device at the space temperature sensing element and transmitter location shall be verified. The temperature setpoint device shall be set to the space temperature setpoint as shown.

(3) The system shall be placed in the unoccupied mode, and it shall be verified that the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback setpoint, and it shall be verified that the

HVAC system stops. The night setback temperature setpoint shall be set at the setpoint.

(4) With the HVAC system running, a filter differential pressure switch input signal shall be simulated, at the device. It shall be verified that the filter alarm is initiated. The differential-pressure switch shall be set at the setpoint.

(5) With the HVAC system running, a freezestat trip input signal shall be simulated, at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(6) With the HVAC system running, a smoke-detector trip input signal shall be simulated at each detector, and verification of control device actions and interlock functions as described in the Sequence of Operation shall be made. Simulation shall be performed without false alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm signal is changed to a return-to-normal signal.

3.4.14 NOT USED

3.4.15 NOT USED

3.4.16 NOT USED

3.4.17 NOT USED

3.4.18 NOT USED

3.4.19 NOT USED

3.4.20 NOT USED

3.4.21 Single Zone with Humidification and Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be verified in its shutdown condition. The system shall be checked to see that power and main air are available where required, and that the outside air damper, humidifier valve and cooling-coil valve are closed.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing elements location. Each temperature shall be read at the DDC panel, and the thermometer and DDC panel display readings logged. The calibration accuracy of the sensing element-to-DDC panel readout for outside air, return air, mixed-air, and cooling-coil discharge-air temperatures shall be checked. A motor-driven psychrometer shall be used to check the wet-bulb and dry-bulb temperatures of the humidifier discharge air

and of the air in the space, and the DDC panel display, the psychrometer, and DDC panel display readings shall be read and logged.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator, through an operator entered value at the DDC panel. The proper operation of the actuators and positioners for all dampers and valves shall be visually verified. The signal shall be varied from live zero to full range, and the actuators travel shall be verified from zero stroke to full stroke within the signal range. It shall be verified that all sequenced and parallel operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control-System Commissioning:

(1) With the fans ready to start, the system shall be placed in the ventilation-delay mode and in the occupied mode signal, and it shall be verified that supply and return fans start. It shall be verified that the outside air damper is closed, and the heating-coil, cooling-coil, and humidifier valves are under control, by simulating a change in the space humidity and the space temperature. The system shall be placed out of the ventilation-delay mode, and it shall be verified that the outside air damper opens.

(2) The two-point calibration accuracy check of sensing element-to-DDC panel readout for the coil discharge air shall be performed. The setpoint for the coil discharge air temperature shall be set as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the preheater control valve is modulated.

(3) The calibration accuracy check for sensing element-to-DDC panel readout for the space temperature shall be performed. Setpoint shall be 70 degrees F at midpoint, 55 degrees F at the low end, and 85 degrees F at the high end. Proper operation of the temperature setpoint device at the space temperature sensing element and transmitter location shall be verified.

(4) The two-point calibration accuracy check for sensing element-to-DDC panel readout for the space relative humidity shall be performed. An identical calibration accuracy check for the duct relative humidity shall be performed. The space relative humidity and the duct relative humidity setpoints shall be set as shown. A change shall be simulated in the space relative humidity or in the duct relative humidity and it shall be verified that the humidifier valve is under control.

(5) The hydronic heating temperature controller "MANUAL/AUTO" station shall be indexed to the "MANUAL" position. The controller output shall be changed to open the converter valve slightly. The two-point calibration accuracy check for sensing element-to-DDC panel readout for the space temperature shall be performed. The temperature setpoint shall be set as shown.

(6) The system shall be placed in the unoccupied mode and it shall be verified that the HVAC system shuts down, and the control system

assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback temperature setpoint and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback temperature setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint as shown.

(7) With the HVAC system running, a filter differential pressure switch input signal shall be simulated at the device. It shall be verified that the filter alarm is initiated. The differential pressure switch shall be set at the setpoint.

(8) With the HVAC system running, a freezestat trip input signal shall be simulated, at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(9) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, and control device actions and interlock functions as described in the Sequence of Operation shall be verified. Simulation shall be performed without false alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm returns to normal.

-- End of Section --

SECTION 15980

INSTRUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Positive displacement meters.

B. Flow meters.

C. Pressure gages and pressure gage taps.

D. Thermometers and thermometer wells.

E. Static pressure and filter gages.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. ASME B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.

B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

C. ASTM D2458 - Method of Flow Measurement by The Venturi Motor Tube.

D. ASTM E1 - Specification for ASTM Thermometers.

E. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.

F. AWWA C700 - Cold Water Meters - Displacement Type.

G. AWWA C701 - Cold Water Meters - Turbine Type for Customer Service.

H. AWWA C702 - Cold Water Meters - Compound Type.

Modular Design System

I. AWWA C706 - Direct Reading Remote Registration Systems for Cold Water Meters.

J. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

K. ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement

L. UL 393 - Indicating Pressure Gages for Fire and Protection Services.

M. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Product Data: For each type of meter, gage, and fitting specified, provide list which includes scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.

B. Product Certificates: Provide product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

C. Maintenance Data: Maintenance Data shall be included in the "Operating and Maintenance Manuals" specified in Section 15010.

D. Submit manufacturer's installation instructions under provisions of Section 15010.

1.4 QUALITY ASSURANCE

A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) Standards pertaining to Construction and Installation

Modular Design System

of Meters and Gages.

B. Design Criteria: The drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages and are based on the specific manufacturer types and models indicated. Meters and gages having equal performance characteristics by other manufacturers may be considered, provided that deviations do not change the design concept or intended performance as judged by the Architect/Engineer. The burden of proof for equality of meters and gages is on the proposer.

1.5 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 15010.

B. Accurately record actual locations of instrumentation.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cole-Parmer Instrument Co.

B. H.O. Trerice Co.

C. Weiss Instruments

2.2 POSITIVE DISPLACEMENT METERS (LIQUID)

A. AWWA C700, positive displacement disc type suitable for fluid with hermetically sealed register, remote reading to AWWA C706.

B. Provide water meters with bronze case with cast iron

frost-proof, breakway bottom cap.

C. Where metering service downstream of utility company meter, meter provided shall be same manufacture as utility company meter.

2.3 PRESSURE GAGES

A. ASME B40.1, UL 393 89 mm diameter drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background, one percent mid-scale accuracy, scale calibrated in both psi and kPa.

B. ASME B40.1, UL 404 diameter cast aluminum case, phosphor bronze bourdon tube, rotary brass movement, brass socket, front recalibration adjustment, black figures on white background, one percent mid-scale accuracy, scale calibrated in both psi and kPa.

2.4 PRESSURE GAGE TAPS

A. Gage Cock: Tee or lever handle, brass for maximum 1034 kPa.

B. Needle Valve: Stainless Steel for maximum 1034 kPa.

C. Pulsation Damper: Pressure snubber, brass with 6 mm connections.

D. Syphon: 6 mm angle or straight pattern.

2.5 STEM TYPE THERMOMETERS

A. ASTM E1, 229 mm scale, red appearing mercury, lens front tube, cast aluminum case with enamel finish and clear glass or polycarbonate window, 50 mm brass stem, 2 percent of scale accuracy to ASTM E77 scale calibrated in both degrees F and degrees C.

2.6 DIAL THERMOMETERS

Modular Design System

A. ASTM E1, 89 mm diameter dial in stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed Lexan lens, stainless steel stem, one percent of full scale accuracy, calibrated in both degrees F and degrees C.

2.7 THERMOMETER SUPPORTS

A. Thermometer Wells:

1. Stainless steel separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2. Stem shall extend 51 mm into fluid.
3. Stem extension for insulated piping shall be 51 mm nominal, but not less than thickness of insulation.

B. Flange: 76 mm outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.8 TEST PLUGS

A. Test Plug: 6 mm or 13 mm stainless steel fitting and cap for receiving 3 mm outside diameter pressure or temperature probe with neoprene core for temperatures up to 93 degrees C.

B. Test Kit: Carrying case, internally padded and fitted containing one 89 mm diameter pressure gages, two gage adapters with 3 mm probes, two 38 mm dial thermometers.

2.9 STATIC PRESSURE GAGES

A. 89 mm diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment with tubing, static pressure tips.

PART 3 EXECUTION

3.1 INSTALLATION

Modular Design System

A. Install in accordance with manufacturer's instructions for applications where used.

B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

C. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage. Install ball valve at each pump tapping so differential pressure may be measured.

D. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage.

E. Install thermometers in piping systems in wells in short couplings. Enlarge pipes smaller than 64 mm for installation of thermometer wells.

F. Install thermometers in air duct systems on flanges.

G. Install thermometer wells adjacent to controls system thermostat, transmitter, or sensor wells. Refer to Section 15951.

H. Locate duct mounted thermometers minimum 3.05 m downstream of mixing dampers, coils, or other devices causing air turbulence.

I. Coil and conceal excess capillary on remote element instruments.

J. Provide instruments with scale ranges selected according to service with largest appropriate scale.

K. Install gages and thermometers in locations where they are easily read from normal operating level.

L. Locate test plugs adjacent to pressure gages and pressure gage taps.

M. Calibrate meters according to manufacturer's written instructions, after installation.

N. Adjust faces of meters and gages to proper angle for best visibility.

O. Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touch-up paint.

3.2 POSITIVE DISPLACEMENT METER SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Domestic cold water Expansion tank make-up	*Operating range of equipment used.

3.3 FLOW METER SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Heating water system Chilled water system	*Operating range of equipment used

3.4 PRESSURE GAGE SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Pumps Expansion tanks	*Fluids Under Pressure 2 times operating pressure.
Chiller - Inlets and Outlets Sprinkler system Pressure reducing valves Backflow preventers	

3.5 PRESSURE GAGE TAP SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Control valves 25 mm & larger - inlets and outlets	(See pressure gages)
Hot water heating coils - inlets and outlets	
Chiller - inlets and outlets	
Boilers - inlets and outlets	
Chilled Water Cooling Coils - inlets and outlets	

3.6 STEM TYPE THERMOMETER SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Boilers - inlets and outlets	0○ to 150○C, w/ 1○C scale divisions
Chiller - inlets and outlets	-18○ to 38○C, w/1○C scale divisions
Domestic Cold Water Supply & Recirculation	-18○ to 38○C, w/1○C scale divisions
Domestic Hot Water Supply & recirculation	0○ to 115○C, w/1○C scale divisions
Hot Water Heating Coils	0○ to 150○C, w/ 1○C scale divisions
Chilled Water Cooling Coil	-18○ to 38○C, w/1○C scale divisions

3.7 THERMOMETER WELL SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Control Valves 25mm & larger - Inlets and outlets	(See thermometers)

Hot Water Unit Heaters
- Inlets and Outlets

3.8 DIAL THERMOMETER SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Outside air	-35○ to 55○C, w/1○C scale divisions
Return air	-18○ to 38○C, w/1○C scale divisions
Mixed air	-18○ to 38○C, w/1○C scale divisions
Cooling Coil Discharge	-18○ to 38○C, w/1○C scale divisions
Heating Coil Discharge	0○ to 83○C, w/1○C scale divisions

3.9 STATIC PRESSURE AND FILTER GAGE SCHEDULE

LOCATION OR SERVICE	SCALE RANGE
Supply fan discharge	(124 Pa to 1493 Pa)
Building static	

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Sound measurement of equipment operating conditions.

E. Vibration measurement of equipment operating conditions.

1.2 CODES AND STANDARDS
(Latest Edition or Revision)

A. AABC MN-1 - National Standards for Total System Balance.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. ANSI S1.4 - Sound Level Meters

D. ANSI S1.11 - Octave-Band and Fractional - Octave Band Analog and Digital Filters

E. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

F. CTI ATC-105 - Acceptance Test Code for Water-Cooling Towers.

G. NEBB-01 - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

H. NFPA90A - Installation of Air conditioning and Ventilating Systems.

I. SMACNA-07 - HVAC Systems Testing, Adjusting, and Balancing.

1.3 SUBMITTALS: Submit under provisions of Section 15010.

A. Agency: Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

B. Field Reports: Submit under provisions of Section 15010.

1. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

C. Data Reports: Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

D. Draft Reports: Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals. Submit six complete sets of draft report.

E. Final Reports: Submit final reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs for each appropriate section, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations. Provide schematic systems diagrams as required. Submit six complete sets of final report.

1. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

F. Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in S.I. Metric units.

G. Calibration Reports: Submit proof that all required

instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 15010.

B. Record actual locations of flow measuring stations, balancing valves and rough setting.

1.5 QUALITY ASSURANCE

A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience certified by AABC.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer. The lead balancing technician's qualification data shall include past experience on at least five similar projects.

1.7 PRE-BALANCING CONFERENCE

A. One week prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect/Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.8 SEQUENCING

A. Sequence work under the provisions of Section 01570.

B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project. Systems shall be fully operational prior to beginning procedures.

C. Test, adjust, and balance the air systems before hydronic and refrigerant systems.

1.9 SCHEDULING

A. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8 deg C wet-bulb temperature of maximum summer design condition, and within 5.6 deg C dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required,

install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.

9. Access doors are closed and duct end caps are in place.

10. Air outlets are installed and connected.

11. Duct system leakage is minimized.

12. Hydronic systems are flushed, filled, and vented.

13. Pumps are rotating correctly.

14. Proper strainer baskets are clean and in place.

15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus 10 percent and minus 5 percent of design for supply systems and plus 10

percent and minus 5 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus 10 percent and minus 5 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 5 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Following final acceptance of certified reports by the Contracting Officer, permanently mark settings of all valves, splitters, dampers, and other adjustment devices allowing settings to be restored if disturbed any time. Set and lock all memory stops.

C. The testing and balancing engineer shall permanently and legibly mark and identify the location points of the duct test ports. If the ductwork has exterior insulation, these markings shall be made on the exterior side of the ductwork insulation. All penetrations through ductwork and ductwork insulation shall be properly sealed to prevent air leakage or loss of vapor barrier.

D. After adjustment, take measurements to verify balance has not been disrupted, or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

A. Before operating the system, perform the following steps.

1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.

2. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.

3. Compare design to installed equipment and field installations.

4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

5. Check filters for cleanliness.

6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

7. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

8. Determine best locations in main and branch ductwork for most accurate duct traverses.

9. Place outlet dampers in the full open position.

10. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

11. Lubricate all motors and bearings.

12. Check fan belt tension.

13. Check fan rotation.

3.6 AIR SYSTEM BALANCING PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes where required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return

air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 12.5 Pa positive static pressure near the building entries.

3.7 PRELIMINARY PROCEDURES FOR HYDRONIC SYSTEM BALANCING

A. Before operating the system perform the following steps:

1. Open valves to full open position. close coil bypass valves.

2. Remove and clean all strainers.

3. Examine hydronic systems and determine if water has been treated and cleaned.

4. Check pump rotation.

5. Clean and set automatic fill valves for required system pressure.

6. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

7. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).

8. Set temperature controls so all coils are calling for full flow.

9. Check operation of automatic bypass valves.

10. Check and set operating temperatures of chillers to design requirements.

11. Lubricate all motors and bearings.

3.8 HYDRONIC SYSTEM BALANCING PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.9 SPECIFIC SYSTEMS

A. Where specific systems require special or additional procedures for testing and balancing, such procedures shall be in accordance with the standard selected in paragraph GENERAL REQUIREMENTS. If a system has diversity, only the required quantity of wide-open terminals shall be used to meet the design water flow.

1. Primary-Secondary: Primary-secondary systems shall be

treated as separate systems. Primary systems shall be balanced first with the secondary systems running. Secondary systems shall then be balanced.

2. Summer-Winter: Summer-winter systems shall be balanced in the summer mode of operation. Following completion of the summer-mode balancing, equipment used for winter operation shall be balanced.

3.10 SOUND LEVEL TESTING

A. After the systems are properly tested, adjusted and balanced, sound levels shall be checked in accordance with the applicable provisions of AABC MN-1. Octave-band analysis and noise-criteria curve data shall be recorded on forms shown in AABC MN-1. All occupied areas including offices, corridors, auditorium and meeting rooms shall be verified to be within the sound levels shown or as specified. Any areas not meeting the requirements of AABC MN-1 or the specifications or drawings shall be clearly indicated on the form and an explanation of all discrepancies shall be provided in test report.

3.11 CONTROL SYSTEMS

A. Testing, adjusting, and balancing of the systems shall be coordinated with the control system installation. All control components shall be verified to be properly installed and operating as specified before proceeding with testing, adjusting, and balancing. Verification shall be in accordance with AABC MN-1.

3.12 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing shall include, and shall not be limited to the following:

1. Plumbing Pumps
2. HVAC Pumps
3. Water Tube Boilers
4. Air Cooled Water Chillers

5. Air Coils
6. Direct Injection Humidifier
7. Air Handling Units
8. Fans
9. Air Filters
10. Air Inlets and Outlets
11. Controls Compressor
12. Infrared Radiant Heating Systems

B. Report Forms

1. Title Page:

   a) Name of Testing, Adjusting, and Balancing Agency
   b) Address of Testing, Adjusting, and Balancing Agency
   c) Telephone number of Testing, Adjusting, and Balancing Agency
   d) Project name
   e) Project location
   f) Project Architect
   g) Project Engineer
   h) Project Contractor
   i) Project altitude
   j) Report date

2. Summary Comments:

   a) Design versus final performance
   b) Notable characteristics of system
   c) Description of systems operation sequence
   d) Summary of outdoor and exhaust flows to indicate amount of building pressurization
   e) Nomenclature used throughout report
   f) Test conditions

3. Instrument List:

   a) Instrument
   b) Manufacturer
   c) Model number
   d) Serial number

e) Range
f) Calibration date

4. Electric Motors:

a) Manufacturer
b) Model/Frame
c) KW
d) Phase, voltage, amperage; nameplate, actual, no load
e) RPM
f) Service factor
g) Starter size, rating, heater elements
h) Sheave Make/Size/Bore

5. V-Belt Drive:

a) Identification/location
b) Required driven RPM
c) Driven sheave, diameter and RPM
d) Belt, size and quantity
e) Motor sheave diameter and RPM
f) Center to center distance, maximum, minimum, and actual

6. Pump Data:

a) Identification/number
b) Manufacturer
c) Size/model
d) Impeller
e) Service
f) Design flow rate, pressure drop, BHP
g) Actual flow rate, pressure drop, BHP
h) Discharge pressure
i) Suction pressure
j) Total operating head pressure
k) Shut off, discharge and suction pressures
l) Shut off, total head pressure

7. Combustion Test:

a) Boiler manufacturer
b) Model number
c) Serial number
d) Firing rate
e) Overfire draft
f) Gas meter timing dial size
g) Gas meter time per revolution
h) Gas pressure at meter outlet
i) Gas flow rate
j) Heat input
k) Burner manifold gas pressure
l) Percent carbon monoxide (CO)
m) Percent carbon dioxide (CO2)
n) Percent oxygen (O2)
o) Percent excess air
p) Flue gas temperature at outlet
q) Ambient temperature
r) Net stack temperature
s) Percent stack loss
t) Percent combustion efficiency
u) Heat output

8. Chillers:

a) Identification/number
b) Manufacturer
c) Capacity
d) Model number
e) Serial number
f) Evaporator entering water temperature, design and actual
g) Evaporator leaving water temperature, design and actual
h) Evaporator pressure drop, design and actual
i) Evaporator water flow rate, design and actual
j) Condenser entering water temperature, design and actual
k) Condenser pressure drop, design and actual
l) Condenser water flow rate, design and actual

9. Cooling Coil Data:

a) Identification/number
b) Location
c) Service
d) Manufacturer
e) Air flow, design and actual
f) Entering air DB temperature, design and actual
g) Entering air WB temperature, design and actual
h) Leaving air DB temperature, design and actual
i) Leaving air WB temperature, design and actual
j) Water flow, design and actual
k) Water pressure drop, design and actual
l) Entering water temperature, design and actual
m) Leaving water temperature, design and actual
n) Saturated suction temperature, design and actual
o) Air pressure drop, design and actual

10. Heating Coil Data:

a) Identification/number
b) Location
c) Service
d) Manufacturer
e) Air flow, design and actual
f) Water flow, design and actual
g) Water pressure drop, design and actual
h) Entering water temperature, design and actual
i) Leaving water temperature, design and actual
j) Entering air temperature, design and actual
k) Leaving air temperature, design and actual
l) Air pressure drop, design and actual

11. Air Moving Equipment

a) Location
b) Manufacturer
c) Model number
d) Serial number
e) Arrangement/Class/Discharge
f) Air flow, specified and actual
g) Return air flow, specified and actual
h) Outside air flow, specified and actual

i) Total static pressure (total external), specified and actual
j) Inlet pressure
k) Discharge pressure
l) Sheave Make/Size/Bore
m) Number of Belts/Make/Size
n) Fan RPM

12. Return Air/Outside Air Data:

a) Identification/location
b) Design air flow
c) Actual air flow
d) Design return air flow
e) Actual return air flow
f) Design outside air flow
g) Actual outside air flow
h) Return air temperature
i) Outside air temperature
j) Required mixed air temperature
k) Actual mixed air temperature
l) Design outside/return air ratio
m) Actual outside/return air ratio

13. Exhaust Fan Data:

a) Location
b) Manufacturer
c) Model number
d) Serial number
e) Air flow, specified and actual
f) Total static pressure (total external), specified and actual
g) Inlet pressure
h) Discharge pressure
i) Sheave Make/Size/Bore
j) Number of Belts/Make/Size
k) Fan RPM

14. Duct Traverse:

a) System zone/branch
b) Duct size
c) Area
d) Design velocity
e) Design air flow
f) Test velocity
g) Test air flow
h) Duct static pressure
i) Air temperature
j) Air correction factor

15. Duct Leak Test:

a) Description of ductwork under test
b) Duct design operating pressure
c) Duct design test static pressure
d) Duct capacity, air flow
e) Maximum allowable leakage duct capacity times leak factor
f) Test apparatus
    1. Blower
    2. Orifice, tube size
    3. Orifice size
    4. Calibrated
g) Test static pressure
h) Test orifice differential pressure
i) Leakage

16. Air Monitoring Station Data:

a) Identification/location
b) System
c) Size
d) Area
e) Design velocity
f) Design air flow
g) Test velocity
h) Test air flow

17. Flow Measuring Station:

Modular Design System

a) Identification/number
b) Location
c) Size
d) Manufacturer
e) Model number
f) Serial number
g) Design Flow rate
h) Design pressure drop
i) Actual/final pressure drop
j) Actual/final flow rate
k) Station calibrated setting

18. Terminal Unit Data:

a) Manufacturer
b) Type, constant, variable, single, dual duct
c) Identification/number
d) Location
e) Model number
f) Size
g) Minimum static pressure
h) Minimum design air flow
i) Maximum design air flow
j) Maximum actual air flow
k) Inlet static pressure

19. Air Distribution Test Sheet:

a) Air terminal number
b) Room number/location
c) Terminal type
d) Terminal size
e) Area factor
f) Design velocity
g) Design air flow
h) Test (final) velocity
i) Test (final) air flow
j) Percent of design air flow

20. Sound Level Report:

Modular Design System

a) Location
b) Octave bands - equipment off
c) Octave bands - equipment on

21. Vibration Test:

a) Location of points:
    1. Fan bearing, drive end
    2. Fan bearing, opposite end
    3. Motor bearing, center (if applicable)
    4. Motor bearing, drive end
    5. Motor bearing, opposite end
    6. Casing (bottom or top)
    7. Casing (side)
    8. Duct after flexible connection (discharge)
    9. Duct after flexible connection (suction)
b) Test readings:
    1. Horizontal, velocity and displacement
    2. Vertical, velocity and displacement
    3. Axial, velocity and displacement
c) Normally acceptable readings, velocity and acceleration
d) Unusual conditions at time of test
e) Vibration source (if non-complying)

END OF SECTION

SECTION 16010

GENERAL PROVISIONS, ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Basic electrical requirements that are applicable to all Division 16 Sections in addition to Division 0 - Contract Requirements and Division 1 - General Requirements.

1.2 RELATED SECTIONS

A. DIVISION 0 - CONTRACT REQUIREMENTS.

B. DIVISION 1 - GENERAL REQUIREMENTS.

C. DIVISION 2 - SITE WORK.

D. DIVISION 3 - CONCRETE

E. DIVISION 7 - THERMAL AND MOISTURE PROTECTION

F. DIVISION 9 - FINISHES.

G. DIVISION 10 - SPECIALTIES.

H. DIVISION 11 - EQUIPMENT

I. DIVISION 14 - CONVEYING SYSTEMS

J. DIVISION 15 - MECHANICAL

1.3 CONTRACTOR'S RESPONSIBILITY:

A. Refer to Section 01440.

1.4 CODES AND STANDARDS

Modular Design System

A. All work shall be manufactured, installed and labeled in accordance with the applicable provisions of the latest editions of the following codes and standards, including Addendums and modifications made by local authorities.
   1. NFC - National Fire Code
   2. NEC - National Electrical Code
   3. SBC - Standard Building Code
   4. SFPC - Standard Fire Prevention Code
   5. UBC - Uniform Building Code
   6. BOCA Basic National Building Code - Building Officials and Code Administrators International, Inc.
   7. NESC - National Electrical Safety Code
   8. NECA - National Electrical Contractors Association
   9. UL - Underwriters Laboratories
   10. NEMA - National Electrical Manufacturers Association
   11. OSHA - Occupational Safety and Health Act
   12. Local codes and ordinances
   13. IEEE - Institute of Electrical & Electronic Engineers
   14. Equipment manufacturer's Published Instructions
   15. Other applicable codes and standards specified in other sections hereinafter.

B. Where the contract documents exceed the code or standard requirements, the Contract Documents shall take precedence.

C. All electrical materials shall be listed by Underwriters' Laboratory (UL), and shall be so labeled where UL labeling is customary.

D. Hardware or software required to process date and time calculations shall be Year 2000 compliant and shall be capable to accurately process date/time data (including but not limited to calculating, comparing, and sequencing) from, into, and in between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the Contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if the other information technology properly exchanges

date/time data with it.

1.5 GOVERNMENT FURNISHED EQUIPMENT AND INSTALLATION

1.6 ACCURACY OF DATA AND DRAWINGS:

A. Drawings and Data: Electrical drawings are generally diagrammatic, and where not dimensioned or detailed, indicate approximate locations and general arrangements of electrical work. Exact conduit routing, offsets, risers, junction boxes, pull boxes, and fittings are not necessarily shown; however, provide these as required by the conditions involved and applicable codes for a correct and complete installation. Provide all inserts, anchors, supports and sleeves as required.

B. The indicated branch circuit conduit routings are intended to show the required circuitry from panelboards to outlets, fixtures and other devices. However, if necessitated by job conditions, deviations from the indicated routings may be made, provided that regardless of the actual installed arrangement of the conduits: each outlet marked with the same circuit number is connected to the same corresponding numbered circuit; outlets are switched and controlled as indicated; and no home run is brought into any switch box unless otherwise indicated.

C. Major equipment items such as panelboards, transformers, switchboards, control panels, etc. are drawn to scale using nominal dimensions based on information of one of the major manufacturer's of the item. The Contractor shall inform prospective equipment suppliers of any space limitations associated with the locations of the equipment and verify that their equipment will or will not fit in the space indicated on the drawings. Proper clearances in front of and around equipment and required for working and cooling shall be maintained as indicated or required by applicable codes or equipment manufacturer's requirements. If there are any conflicts, the Contractor shall notify the Resident Officer In Charge before the project Bid Date.

D. Building and structure dimensions: TAKE THESE FROM ARCHITECTURAL AND STRUCTURAL DRAWINGS.

E. Equipment NOT furnished by Electrical Section but requiring electrical connections: from other sections and others furnishing this equipment, determine exact electrical connection requirements therefore. Locations and arrangements of electrical connections indicated for this equipment are APPROXIMATE ONLY. Refer to Section 16180.

1.7 SUBMITTALS: Submittals shall be provided to the Engineer as described in Section 01300.

A. All Devices: Submittals shall be made for all wire, conduit, equipment and devices described in this specification. See appropriate section for detailed information to be included in the submittal.

1.8 GROUNDING:

A. Ground electrical equipment and conductors as required by NEC and other applicable electrical codes. Refer to Section 16170.

1.9 TYPE OF SYSTEM, WIRING METHOD:

A. Electrical system characteristics: Voltages and amperages shall be as indicated.

B. Regardless of voltage or use, install wiring in conduits and metal or other enclosures, unless otherwise indicated or otherwise specified.

1.10 TEMPORARY CONSTRUCTION POWER:

A. The Contractor shall provide temporary power service equipment, lighting fixtures, devices, and wiring as required for the project.

PART 2 PRODUCTS

Modular Design System

2.1 HOUSEKEEPING PADS

A. Provide 100 mm high concrete pads for all floor mounted electrical equipment such as transformers, switchgear, large distribution panels, etc. The pad dimensions shall be approximately 50 mm larger than the equipment in the width and depth dimensions. Bevel the edges of the pad to reduce chipping. Refer to Section 03300 for concrete specifications.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION:

A. Copies of applicable equipment manufacturer's installation drawings and instructions shall be kept on site.

3.2 TESTS, INSPECTIONS, ADJUSTMENTS AND CLEANUP:

A. Perform work in accordance with Section 01451.

B. Furnish suitable testing equipment, give the Contracting Officer's Representative and all applicable authorities 10 working days advance notice of all proposed tests and readiness of work for observations, and conduct each test in their presence, as approved. Do not conceal electrical work until all necessary observations have been made and all required tests have been approved by the Engineer and all applicable authorities.

C. Put entire electrical system in operation, test all equipment, remedy all defects and make all necessary adjustments. Demonstrate that the entire system functions satisfactorily, as specified, as indicated and as approved.

D. Clean all electrical work thoroughly. Remove foreign matter which has accumulated in all fixtures, equipment, and enclosures. Clean all fixture glassware and reflectors and clean and polish all other surfaces that are not to be painted so that they present a new and acceptable

appearance. Manufacturer's cleaning instructions shall be followed if applicable. Any finished surfaces that are scratched or marred shall be touched up or refinished with materials approved by the manufacturer.

3.3 FIELD PAINTING:

A. Refer to Section 09900.

3.4 PROTECTION AND CLEANING:

A. Work shall be protected at all times. Conduit openings shall be closed with caps or plugs until permanent connections are made. Fixtures and equipment shall be covered, if necessary, to protect against dirt, water, chemical or mechanical damage or defacement.

3.5 OPERATING INSTRUCTIONS:

A. Furnish the services of a competent person (or persons) to instruct the Owner's personnel in the proper operation and maintenance of all equipment, for each system.

B. Furnish and deliver to the User operation and maintenance manuals for all equipment installed under this contract.

3.6 AS-BUILT DRAWINGS:

A. The Contractor shall provide as-built drawings in accordance with Section 00800.

3.7 GUARANTEE:

A. The Contractor shall guarantee all work in accordance with Section 01440.

END OF SECTION

SECTION 16111

CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rigid metal conduit.

B. Intermediate metal conduit.

C. Flexible metal conduit.

D. Liquidtight flexible metal conduit.

E. Electrical metallic tubing.

F. Rigid PVC conduit.

G. Fittings and conduit bodies.

1.2 RELATED SECTIONS

A. Division 0 - Contract Requirements.

B. Division 1 - General Requirements.

C. Section 07270 - Fire Stopping.

D. Section 07416 - Seam Metal Roof System.

E. Section 07620 - Sheet Metal Flashing and Trim.

F. Section 16010 - General Provisions - Electrical

G. Section 16170 - Grounding and Bonding.

H. Section 16180 - Equipment Wiring Systems.

I. Section 16190 - Supporting Devices.

J. Section 16195 - Electrical Identification.

1.3 CODES AND STANDARDS

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

C. ANSI C80.6: Intermediate Metal Conduit (IMC).

D. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

E. ANSI/NFPA 70 - National Electrical Code.

F. NECA "Standard of Installation."

G. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

H. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

J. UL 1: Flexible Metal Conduit.

K. UL 6: Rigid Metal Conduit.

L. UL 360: Liquidtight Flexible Steel Conduit.

M. UL 514B: Fittings for Conduit and Outlet Boxes.

N. UL 651: Schedule 40 and 80 Rigid PVC Conduit.

O. UL 797: Electrical Metallic Tubing.

P. UL 886: Fittings for Use in Hazardous (Classified) Locations.

Q. UL 1242: Intermediate Metal Conduit.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information for each type of conduit, conduit body, fitting and attachment device.

1. Conduit

a. Type of material
b. Thickness of material
c. Types of protective coatings on the outside and inside.
d. Type of protective coating on threads, if applicable.

2. Conduit Bodies

a. Type of material
b. Type of cover material
c. Type of protective coatings; interior and exterior.
d. Type of material for screws and gaskets.

3. Conduit Fittings

a. Type of materials such as bodies, gaskets, seals, etc.
b. Threaded
c. Compression or set screw type
d. Liquid tight
e. Concrete tight

1.5 PROJECT RECORD DOCUMENTS

A. Record the actual routing of all feeder conduits to switchboards, panelboards, etc. and all underground conduit or conduit concealed in or under the slab in contact with the ground. Indicate the location of junction and pull boxes and sealing fittings and expansion fittings in these conduits.

Dimension the locations of conduits, boxes and fittings on the drawings referenced from the exterior walls, columns or corners of the building. Record any modifications, deletions or additions to the branch circuitry indicated on the original drawings.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated. Products shall bear the UL label.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. The threads of rigid steel and IMC shall be protected by factory installed caps.

D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:

1. Allied
2. LTV Steel Tubular Products Co.
3. Triangle
4. Wheatland
5. Substitutions: Approved Equal.

B. Rigid Steel Conduit (RSC): RSC shall be threaded, hot dip galvanized inside and outside with a chromate coating outside. Threads shall be zinc coated after cutting. Elbows

and nipples shall conform to the same specification.

C. Intermediate Metal Conduit (IMC): IMC shall be threaded, hot-dip or electro-galvanized outside with chromate coating. The inside shall be galvanized or coated with paint, zinc, enamel or other corrosion protection material that also provides a smooth, low friction surface. The threads shall be zinc coated after cutting. Elbows and nipples shall conform to the same specification.

D. Couplings: Couplings shall be threaded, hot-dip or electro-galvanized steel with chromate coating and made by the same manufacturer as the conduit.

2.2 PVC COATED METAL CONDUIT

A. Manufacturers:

1. Robroy, Inc.
2. OCAL
3. Perma-Cote Industries

B. Description: Conduit shall be rigid steel, hot-dip galvanized inside and outside including the threads. The exterior surface shall be treated prior to coating. Both interior and exterior shall be coated with an apoxy acrylic primer. The exterior shall be coated with a minimum 0.1 mm thick PVC coating. The interior shall be coated with a nominal .005 mm thick urethane coating. The conduit shall be bendable without damage to either the PVC or urethane coating. The threads shall be coated with a nominal .005 mm thick clear urethane coating. Elbows and nipples shall conform to the same specification.

C. Couplings, Fittings and Conduit Bodies:

1. Couplings shall be galvanized steel and made by the same manufacturer as the conduit.

2. Fittings shall be malleable iron or steel.

3. Conduit bodies shall be copper free cast aluminum or malleable iron with cast covers and stainless steel screws.

4. All couplings, conduit fittings and conduit bodies shall have the same exterior and interior coatings as specified for the conduit.

5. Threads shall have the same .005 mm clear urethane coating as specified for the conduit.

6. The exterior PVC material shall form a sleeve extending one pipe diameter or 50 mm, whichever is less, from each female opening of couplings, fittings and conduit bodies.

7. Clamps, U-bolts, and other devices used to secure the conduit shall be malleable iron or steel with the same PVC coating as the conduit.

8. Couplings, fittings and conduit bodies shall be of the same manufacturer as the conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC
2. Alflex Corp.
3. Anamet, Inc.
4. Electri-Flex Co.

B. Description: Interlocked galvanized steel.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC
2. Alflex
3. Anamet Inc.
4. Carol

4. Electri-Flex Co.
5. Spiraduct

B. Description: Interlocked galvanized steel with extruded PVC jacket.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube and Conduit.
2. LTV Steel Tubular Products Co.
3. Triangle PWC Inc.
4. Wheatland Tube Co.

B. Description: EMT shall be hot-dip or electro-galvanized on the outside with a chromate coating. The interior shall be coated with paint, zinc, enamel or other corrosion protection material that also provides a smooth low friction surface.

2.6 NONMETALLIC CONDUIT

A. Manufacturers:

1. Carlon
2. Can-Tex Industries
3. Georgia Pipe

B. Description: PVC; Schedule 40 and 80 PVC as indicated or specified.

C. Fittings: Fittings shall match conduit type and material and shall be provided by the same manufacturer as the conduit.

D. Cement for connections of conduit and fittings shall be approved by the manufacturer of the conduit.

2.7 FITTINGS AND CONDUIT BODIES FOR METAL, EMT AND FLEXIBLE CONDUIT

A. Fittings

Modular Design System

1. Manufacturers:

    a. Appleton
    b. Crouse-Hinds
    c. Raco
    d. O.Z./Gedney
    e. Midwest Electric
    f. Steel City
    g. Thomas and Betts

2. Description:

    a. All fittings, locknuts, bushings, etc. shall be malleable iron or steel.
    b. For RSC or IMC, fittings shall be threaded type.
    c. For EMT, fittings shall be compression or set screw type.
    d. Locknuts shall have shape edges that bite into the enclosure when tightened.
    e. Bushings shall be high temperature plastic, with insulating throats and grounding lugs where applicable.
    f. Hub fittings shall be two-piece, liquid-tight with high temperature, plastic, insulating throats.
    g. Fittings used in concrete shall be UL Listed as concrete tight.
    h. Fittings used in exterior and other damp or wet applications shall be UL Listed as liquid tight.
    i. Fittings for flexible metal conduit have insulated throats and grounding lugs where applicable.
    j. Refer to the PVC coated metal conduit and nonmetallic conduit specifications for fittings used with those types of conduit.
    k. Sealing bushings shall have molded neoprene sealing ring with predrilled holes for each conductor, PVC coated pressure discs, stainless steel screws and washers and locking ring where applicable.

B. Conduit Bodies:

Modular Design System

1. Manufacturers:

    a. Appleton
    b. Crouse-Hinds
    c. O-Z/Gedney
    d. Midwest Electric
    e. Steel City
    f. Raco
    g. Killark

2. Description: Conduit bodies shall be malleable iron or cast copper-free aluminum. They shall be threaded type with cast cover and solid gasket. Where used in dry interior applications, provide coated steel screws. Where used in exterior or other damp or wet applications, use stainless steel screws. Conduit bodies 35 mm and larger shall have rollers or wire guards.

C. Expansion fittings:

1. Manufacturers:

    a. Appleton
    b. Crouse-Hinds
    c. O.Z./Gedney

2. Description: These shall be malleable iron or steel with insulator bushing, gaskets, washers, packing, etc. as required to provide a complete unit. Provide a braided copper bonding jumper. The fitting shall be rated for interior or exterior use as applicable.

D. Seal Fittings:

1. Manufacturers

    a. Appleton
    b. Crouse-Hinds
    c. O.Z./Gedney

2. Description: Seal fittings shall be malleable iron or

cast aluminum, threaded type with, packing, sealing compound, plugs, etc. to provide a complete unit. Fittings shall be rated for interior or exterior use as applicable.

E. Deflection Fittings

1. Manufacturers

a. Appleton
b. Crouse-Hinds
c. O.Z./Gedney

2. Description: Deflection fittings shall be hot-dip galvanized ductile iron, threaded type with molded neoprene outer jacket, tinned braided copper bonding jumper, molded plastic inter sleeve, stainless steel clamping bands, etc. to provide a complete unit. The fitting shall be rated for interior or exterior use as applicable. Where fittings are used below grade, they shall be PVC coated as specified under PVC coated metal conduit fittings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Underground Installation:

1. More than Five Feet from Foundation Wall: Use rigid steel conduit, intermediate metal conduit, plastic coated conduit and rigid nonmetallic conduit.

2. Within Five Feet from Foundation Wall: Use rigid steel conduit, and plastic coated conduit.

3. In or Under Slab on Grade: Use rigid steel conduit, and plastic coated conduit.

B. Outdoor Locations, Above Grade: Use rigid steel and intermediate metal conduit.

C. In Slab Above Grade:

1. Use plastic coated conduit.

D. Wet and Damp Locations: Use rigid steel conduit, intermediate metal conduit, and rigid nonmetallic conduit.

E. Dry Locations:

1. Concealed in concrete or masonry construction above grade, columns, walls and above suspended ceilings: Use rigid steel conduit, intermediate metal conduit, and electrical metallic tubing.

2. Exposed: use rigid steel, intermediate metal conduit, and electrical metallic tubing.

F. Locations Subject to Physical Damage: Use rigid steel conduit or intermediate metal conduit.

G. Corrosive Environments: PVC coated rigid steel.

H. Hazardous Areas or Feeds to Fire Pumps: Use rigid steel or intermediate metal conduit.

I. Service Entrance Conduit - Overhead (600 volts or less): Use rigid steel conduit or intermediate metal conduit from the service entrance equipment to the service entrance fitting or weatherhead outside the building.

Service Entrance Conduit - Underground (600 volts or less): Use PVC coated rigid steel or schedule 40 PVC with the underground portion encased in a minimum of 75 mm of concrete and installed a minimum of .450 mm below grade. Convert PVC conduit to PVC coated rigid steel before rising through the floor slab or grade. The PVC coated rigid steel conduit shall extend a minimum of 150 mm above the floor or grade.

J. Flexible Metal Conduit: Flexible metal conduit shall be installed for:

1. Connections from the conduit system to recessed lighting fixtures, maximum 1.8 m in length.

2. Connections to motors, maximum .6 m in length.

3. Connections to electrical equipment subject to movement or vibration.

K. Liquid-Tight Flexible Metal Conduit: Liquid-tight flexible metal conduit shall be installed for:

1. Connections to motor or equipment subject to movement or vibration where exposed to rain, spray, or a corrosive atmosphere.

2. Connections to equipment subject to oil or grease.

3. Connections to fire pumps and auxiliary equipment.

L. General Requirements:

1. Install conduit in accordance with NECA "Standard of Installation" and manufacturer's written instructions.

2. Install nonmetallic conduit in accordance with manufacturer's instructions.

3. Minimum Size: 13 mm unless otherwise specified.

4. Field measurements: Refer to 16010.

5. Verify routing and termination requirements and locations of conduit prior to rough-in.

6. Routing and termination of conduits shall be coordinated with structural, equipment, piping and ductwork to assure accessibility to junction and pull boxes.

7. Conduit routing shown on the drawings is diagramatic unless otherwise dimensioned. Route conduit as specified and as required. Conduit offsets, risers, junction

boxes, pull boxes, and fittings are not necessarily shown; however, provide these as required by the conditions involved and applicable codes for a correct and complete installation.

8. Finished Areas: Conceal conduits below floors, within slabs only where indicated, within walls, within pipe chases, above suspended ceilings, and within other building construction, unless otherwise indicated. Conduits shall not be run in floor slabs except where otherwise indicated.

9. Unfinished Areas: Install above-floor conduits exposed in areas where pipe chases or suspended ceilings are not indicated or concealing is otherwise impracticable, in mechanical and electrical equipment rooms, storage areas, and other unfinished areas.

10. Install conduits run exposed or concealed above ceilings or in walls in straight, level and plumb lines, parallel with and at right angles with beams, wall, ceilings and other building lines.

11. Route conduit in slabs above grade and in and under slabs on grade from point-to-point or shortest practical path.

12. All individual suspended conduits (63 mm or larger) and all trapeze hangers where hanger rods are over 300 mm in length from the point of attachment to the structure, shall be provided with seismic sway bracing. Conduits shall not be supported from the ceiling hanger wires or ceiling tee bars except for short runs of up to 19 mm branch circuit conduits which run from a wall or structural member and terminate in an outlet box mounted in or on the ceiling. Conduits supported on the ceiling tees shall be supported on the main runners only. A maximum of two 21 mm conduits may be supported from any single hanger wire and attached only in the upper and lower 300 mm of the hanger wire. Conduits shall not be run across and secured directly to the ceiling tee bar system that will prohibit the raising and removal of the

ceiling tile. Additional hanger wires may be provided as conduit supports. These wires shall be the same size as the ceiling support wires and shall be attached to the ceiling grid and the structure above. They shall be tight without deforming the ceiling grid.

13. Arrange supports to prevent misalignment during wiring installation.

14. Support individual conduit using coated steel or malleable one hole conduit straps, lay-in adjustable hangers, clevis hangers, threaded rods with conduit fasteners and split hangers.

15. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits. Each conduit shall be independently attached to the rack.

16. Fasten conduit supports to building structure and surfaces under provisions of Section 16190. Do not fasten conduit supports to mechanical piping or ducts or their supports.

17. Do not support conduit with tie wire or perforated pipe straps. Remove wire used for temporary supports.

18. Do not cross conduits in slab.

19. Conduit shall be installed a minimum of 300 mm from steam or hot water piping, flues or any other surface with a surface temperature exceeding 40 degrees C run in parallel with the conduit, and a minimum of 150 mm where run perpendicular to the conduit. Conduit shall be installed a minimum of 75 mm from cold or chilled water piping.

20. Cut conduit square using saw or pipecutter; ream and de-burr cut ends.

21. Bring conduit to shoulder of fittings; fasten wrench-

tight.

22. When threads are cut in rigid steel or intermediate metal conduit in the field, the conduit and fittings shall be made up immediately. If there are any threads showing, they shall be coated with a corrosion resistant compound approved by the conduit manufacturer.

23. When threads are cut in PVC coated rigid steel conduit in the field, the threads shall be coated immediately with a corrosion resistant compound supplied by the conduit manufacturer. When the PVC coating of the conduit is removed or damaged for any reason, the exposed area shall be coated with a PVC compound supplied by the conduit manufacturer. Follow the manufacturer's instructions in applying compounds.

24. Solvent weld nonmetallic conduit and fittings using cement as approved by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure as instructed by the manufacturer.

25. Use conduit hubs or water tight fittings to fasten conduit to metal boxes in damp and wet locations.

26. Install no more than equivalent of three 90-degree bends between pull or outlet boxes. Make field-made bends and offsets with hickey or conduit bending machine. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 50 mm size. Do not install crushed or deformed conduits. Keep the legs of a bend in the same plane and the straight legs of offsets parallel. For banked runs, all bends and offsets shall be parallel.

27. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

28. Provide approved adapters when PVC conduits are coupled

to metallic conduits.

29. Where PVC is used underground, a PVC coated rigid steel elbow shall be provided at the point where the conduit turns up. The vertical portion of the riser shall be PVC coated rigid steel conduit to a point 150 mm minimum above grade or floor slab.

30. Provide approved fittings that maintain conduit electrical continuity by bonding jumpers or other means to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.

31. Provide seal fittings on all conduits where they rise out of the ground or fill below slabs. If the conduit terminates in a floor mounted metal enclosure such as a switchboard, pull box, etc., provide a sealing bushing as specified with a grounding bushing.

32. Provide seal fittings on all conduits that penetrate exterior walls to or from interior spaces or other areas where conduit passes from one extreme temperature or moisture situation to another such as walk-in refrigerators, freezers or wash down bays.

33. Install a pull line in each empty conduit except sleeves and nipples in which wire or cable is to be installed by others if the conduit is more than 15 m in length and contains more than the equivalent of two 90 degree bends or where the conduit is more than 150 feet (45 m) in length. Pull lines shall be monofilament plastic having a minimum 90 kg tensile strength. Leave a minimum of 300 mm of slack at each end of the pull line.

34. Where conduits rise through floor slabs, curved portions of bends shall not be visible above the finished slab.

35. Support non-concrete encased underground conduits by laying with full length bearing on firm trench bottoms.

36. Support horizontal and vertical runs of conduit at

intervals in accordance with the code for the types of conduit used. In addition, support each riser conduit at each building floor level.

37. Prior to wire pulling, use suitable caps to protect installed conduit against entrance of dirt and moisture and blow out or swab out conduits in which moisture or dirt has collected. Free clogged conduits of obstructions.

38. Ground and bond conduit under provisions of Section 16170.

39. Identify conduit under provisions of Section 16195.

40. Provide all necessary sleeves for conduits and other electrical items passing through concrete and masonry construction where conduit and other electrical items are not installed prior to concrete placing or masonry laying. Sleeves through concrete walls, concrete columns, and concrete beams shall be IPS steel pipe or rigid steel conduit, flush with finished concrete surfaces. Sleeves for all conduits passing through the floor shall be galvanized IPS pipe or galvanized rigid steel conduit extending two inches above finished floor, and flush with slab below.

41. Install conduit to preserve fire and smoke resistance rating of partitions, floors and other elements.

42. Route conduit through suitable roof flashing devices. Coordinate with roofing installation specified under Section 07620.

43. Provide insulating bushings on all feeder conduits.

44. Provide code size pull boxes, in accessible locations, in all conduits where the number and degree of bends exceed the code limitations and every 45 m maximum for long straight runs.

45. All conduits that are stubbed out below grade shall have a threaded, watertight cap installed on the end.

46. Individual and grouped conduits suspended above accessible ceilings shall be located a sufficient distance above the ceiling to permit the removal of the ceiling tile.

47. Conduits shall be located so as not to hinder access to mechanical and electrical equipment through the ceiling tiles.

48. Exposed suspended conduits shall be located as to provide proper headroom as required by O.S.H.A. regulations.

49. Conduit runs shall be complete before conductors are installed in them.

M. EXCAVATION AND BACKFILL

1. Excavate and backfill as required for the electrical work. Cut bottoms of trenches to the proper lines and grades to provide firm and continuous support for the underground electrical work, and to provide 600 mm MINIMUM depth or as required by the NEC if more than 600 mm from finished grade to tops of all exterior underground electrical work. Sheet and brace excavations as required to protect personnel and adjacent structures.

2. After the underground electrical work has been installed and approved, place all backfill in 200 mm maximum thickness loose layers, and compact each layer to at least the density of the adjacent undisturbed site soil, using pneumatic or other suitable power tampers. Mass backfilling (backfilling without tamping) is prohibited.

3. Warning tape for buried electrical work: Install detectable warning tape directly over every device by burying tape as close to the surface as possible, but no less than 150 mm beneath finish grade. One strip of warning tape shall be placed parallel and directly above

the conduit. Where conduits are banked and the width of the conduit bank is over 300 mm, strips shall be placed parallel, on 300 mm centers, centered directly above the conduit bank. Refer to Section 16195.

N. Conduits Embedded in Slabs:

1. Conduits shall be installed in slabs only where indicated.

2. Install in middle third of the slab thickness where practical, and leave a minimum of 25 mm concrete cover.

3. Do not stack conduits.

4. Outside diameter of the conduit shall not exceed 1/3 of the slab thickness.

5. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

6. Space raceways laterally to prevent voids in the concrete. Conduits shall be spaced no closer than 3 diameters on center except at cabinet locations.

7. Run conduit larger than 25 mm trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.

END OF SECTION

SECTION 16114

CABLE TRAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cable trays and accessories.

1.2 CODES AND STANDARDS

A. ANSI/NFPA 70 - National Electrical Code.

B. ASTM A 123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

C. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process.

D. NEMA VE 1 - Metallic Cable Tray Systems.

1.3 SUBMITTALS

A. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

B. Product Data: Provide data for fittings and accessories.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 PROJECT RECORD DOCUMENTS

A. Record actual routing of cable tray and locations of supports.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Square D.

B. B-Line.

C. Substitutions: Approved Equal.

2.2 LADDER-TYPE CABLE TRAY

A. Description: NEMA VE 1, Class 20C ladder type tray.

B. Material: Steel.

C. Finish: ASTM A 123, hot dipped galvanized after fabrication. Painted with gray epoxy.

D. Inside Width: 9 inches as indicated.

E. Inside Depth: 6 inches.

F. Straight Section Rung Spacing: 9 inches on center.

G. Inside Radius of Fittings: 24 inches.

H. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

2.3 WARNING SIGNS

Modular Design System

A. Engraved Nameplates: 1/2 inch high black letters on yellow laminated plastic nameplate, engraved with the following wording:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install metallic cable tray in accordance with NEMA VE 1.

C. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 ft maximum.

D. Use expansion connectors where required.

E. Ground and bond cable tray under provisions of Section 16170.
   1. Provide continuity between tray components.
   2. Provide 2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component.
   3. Connections to tray may be made using mechanical or exothermic connectors.

F. Install warning signs at 50 ft centers along cable tray, located to be visible.

END OF SECTION

SECTION 16117

MANHOLES

PART 3 GENERAL

1.1 SECTION INCLUDES

A. Prefabricated concrete manholes.

B. Manhole accessories.

1.2 RELATED WORK

1. Section 16111 - Conduit.

2. Section 16375 - Electrical Distribution System, Underground.

3. Section 16130 - Boxes.

4. Section 16170 - Grounding.

1.3 REFERENCES

A. AASHO H-20 - Standard Specification for Highway Bridges.

B. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.

D. ASTM A48 - Gray Iron Castings.

E. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.4 QUALITY ASSURANCE

Modular Design System

A. Manufacturer: Company specializing in precast concrete structures with three years documented experience.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 16010 - ELECTRICAL GENERAL CONDITIONS.

B. Indicate material specifications, dimensions, capacities, size and location of openings, reinforcing details, and accessory locations.

C. Provide product data for manhole accessories.

D. Submit manufacturer's installation instructions in accordance with Section 16010 - ELECTRICAL GENERAL CONDITIONS.

PART 3 PRODUCTS

2.1 MANUFACTURERS - PRECAST CONCRETE MANHOLES

A. Cloud Concrete.

B. Substitutions: Approved Equal.

2.2 PRECAST CONCRETE MANHOLES

A. Precast Concrete: Air-entrained, 2000 psi (20 mPa) compressive strength at 28 days.

B. Reinforcing: AASHO H-20; bridge loading.

C. Construction: In modular sections with tongue and groove joints.

D. Manhole Shape: Square.

E. Include 900 mm diameter grooved opening in top section.

F. Necking and Shaft Sections: 760 mm diameter clear opening.

G. Include 300 mm drain opening and 2 25 mm ground rod openings in base section.

H. Window for Duct Entry: 910 mm x 910 mm on each wall, with top of opening 610 mm below top of manhole.

I. Include cable pulling irons opposite each duct entry window.

J. Include inserts for cable racks at 1230 mm on center.

K. Include precast manhole steps at 400 mm on center.

2.3 MANHOLE ACCESSORIES

A. Manhole Frames and Covers: ASTM A48; Class 30B gray cast iron, machine finished with flat bearing surfaces.

B. Sump Covers: ASTM A48; Class 30B gray cast iron.

C. Pulling Irons: 22 mm diameter steel bar forming a triangle of 225 mm per side when set. Galvanize to ANSI/ASTM A153 for irregular shaped articles.

D. Cable Rack Inserts: Steel channel insert with minimum load rating of 364 kg, length to match cable rack channel.

E. Cable Rack Channel: 100 x 38 x 5 mm steel channel wall bracket, 1.2 m length, with cable rack arm mounting slots on 200 mm centers.

F. Cable Racks: ANSI/ASTM A569; steel channel, 64 x 350 mm, with high-glazed wet-process porcelain insulators.

G. Manhole Steps: Cast iron, suitable for manhole shape and construction.

PART 3 EXECUTION

3.1 PREPARATION

A. Excavate, install base material, and compact base material in accordance with manufacturer's instructions.

3.2 INSTALLATION - PRECAST CONCRETE MANHOLES

A. Install and seal precast sections in accordance with manufacturer's instructions.

B. Use precast neck and shaft sections to bring manhole entrance to proper elevation.

C. Install manholes plumb.

D. Set the top of each manhole to finished elevation.

E. Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and pacing. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. In paved areas, the top of the manhole covers shall be approximately 15 mm above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast-in-place with the manhole. Duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell.

F. Ground rods installed in manholes shall be connected to cable racks, cable-pulling irons, the cable shielding,

metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 50 mm above and 150 mm below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole walls and the amount of exposed bare wire shall be held to a minimum.

3.3 INSTALLATION - MANHOLE ACCESSORIES

A. Install ground rod with top protruding 100 mm above manhole floor.

B. Waterproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days minimum.

C. Attach cable racks to inserts after manhole installation is complete.

END OF SECTION

SECTION 16118

UTILITY PITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prefabricated utility pits.

B. Utility pit accessories.

1.2 RELATED WORK

1. Section 16111 - Conduit.

2. Section 16130 - Boxes.

3. Section 16170 - Grounding.

1.3 REFERENCES

A. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in prefabricated utility pits with three years documented experience.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 16010 - ELECTRICAL GENERAL CONDITIONS.

B. Indicate material specifications, dimensions, capacities, size and location of openings, reinforcing details, and accessory locations.

C. Provide product data for utility pit accessories.

D. Submit manufacturer's installation instructions in accordance with Section 16010 - ELECTRICAL GENERAL CONDITIONS.

PART 2 PRODUCTS

2.1 MANUFACTURERS - PREFABRICATED UTILITY PITS

A. Dabico

B. GNY

C. Substitutions: Approved Equal.

2.2 PIT COVER

A. Shall be all primary metal cast aluminum, No. A356.2, per Fed. Spec. QQ-A-601F with a T-6 heat treat per Mil. Spec. H-6088F, with no exceptions. Service lettering (for cover larger than 279 mm O.D.) shall be abrasion/corrosion/chemical resistant, color coded, polyester powder coated. Cover 457 mm (or 444 mm, for 457 mm O.D. Pit) access door(s) shall have hand-hole(s) with a minimum 35 mm depth and 229 cu. cm. volume. Cover door(s) shall have a maximum 14 kg lift with a maximum 213 kg-centimeters of work to open and close it, using a non-load bearing, internally mounted hinge mechanism that prevents door from slamming open or shut; providing a minimum 431 mm diameter opening, and access under opening to highest pit internal component at a maximum of 102 mm from pit top, if applicable.

B. Each cover style's prototype test report shall be submitted and the test shall have been conducted by an independent testing company in the following manner: cover loading over each (or each of two, spaced at a maximum of 915 mm on centers for pit with inside length greater than 1524 mm,) 1291 sq. cm (or 613 sq. cm, for 279 mm O.D. cover,) footprint(s) shall result in a minimum 70 kg/sq. cm (or 52 kg/sq. cm, for 279 mm O.D. cover,) rating with a maximum 2.54 mm (or 3,81 mm, for cover larger than 788 mm square,) full load deflection at center indicator(s) and deflection "rebound" within 0.254 mm after load release. Cover shall also comply with DOT AC 150/5320-6C.

C. Cover must be free of: visual shrink porosity cavity areas, fillers, weldments and paint to hide them (area colored/point-welded for information is allowed). Weight bearing mating flange surfaces of the pit and cover shall be flat to within 1.27 mm total indicator reading. Concrete splash guard shall be provided to cover entire top surface of pit/form. The manufacturer shall submit proof of at least fifteen years experience in the usage of cast aluminum covers for airfield applications.

2.3 PIT COVER SEAL

A. Door seal shall automatically engage cover frame when door is seated in the closed position without any secondary latching motions. Door seal shall be affixed without mechanical fasteners. Door seal shall have a minimum field life of 1 year, and shall be ozone/UV resistant. Door sealing surface shall be separate from load-bearing surface. Cover frame shall have its own seal.

B. Prototype cover assembly's environmental test report shall be submitted and the test shall have been conducted by an independent testing company in the following categories and standards: Totally submerged cover door and frame shall pass less than 100 grams of water per hour following: a) hot (71 deg. C) and cold (-40 deg. C) cycling conforming to Mil Std-810 and, b) seal contamination (door seal area & mating frame sealing surface packed with sand and soil). In addition, cover assembly shall pass submersion, corrosion and hose down tests equal to NEMA 250 standards for Type 6 exterior enclosures.

2.4 PIT/FORM

Shall be prefabricated per the plan detail dimensions with a drain coupling, if a pit drainage system is provided. Non-torsion-actuated pit shall be: all fiberglass, or for 457 mm & 609 mm O.D. and 635 mm square pits - fiberglass with a galvanized steel top flange to be integrally bonded to the

fiberglass in a non-bolted arrangement with a minimum 101 mm overlap. The integral top flange shall re;quire no extraneous corrosive material, weldments or strongbacks to support the cover. Overall depth of isolation valve pits shall be based on 2 times (for ball & butterfly valves) or 3 times (for plug/double block & bleed valves) the pipe's O.D. underneath the pipe centerline, rounded up to nearest 304.8 mm. The manufacturer shall submit proof of at least fifteen years experience in the usage of fiberglass pits for airfield applications.

2.5 PIT INTERNAL COMPONENTS

All the pit internal components shown and described in the plans and specifications shall be provided by the pit manufacturer as a completely factory assembled package with pipe/conduit stub(s) as follows: 152.4 mm (for pipe sizes up to 101.6 mm) or 304.8 mm (for pipe sizes 152.4 mm to 304.8 mm) or pipe O.D. (for pipe sizes 355.6 mm & larger) for side entry, even with bottom of the pit for bottom entry, or just outside the pit wall for coupling(s)/seal-off(s).

2.6 UTILITY PIT ACCESSORIES

PART 3 EXECUTION

3.1 PREPARATION

A. Excavate, install base material, and compact base material in accordance with manufacturer's instructions.

3.2 INSTALLATION - PRECAST CONCRETE MANHOLES

A. Install and seal in accordance with manufacturer's instructions.

B. Install utility pits plumb.

C. Set the top of each pit to finished elevation.

D. Waterproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days minimum.

END OF SECTION

SECTION 16123

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building wire and cable.

B. Wiring connectors and connections.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions, - Electrical.

B. Section 16111 - Conduit.

C. Section 16112 - Surface Raceways.

D. Section 16130 - Boxes.

E. Section 16170 - Grounding and Bonding

F. Section 16180 - Equipment Wiring Systems.

G. Section 16195 - Identification.

1.3 CODES AND STANDARDS

A. NECA - Standard of Installation

B. NEMA WC 5 - Thermoplastic - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

C. NEMA WC 26 - Wire and Cable Packaging.

D. NFPA 70 - National Electrical Code.

E. UL 83 - Thermoplastic - Insulated Wires and Cables.

F. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

G. UL 510 - Insulating Tape.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different type of wire and connector. The information shall be in the form of manufacturer's standard data sheets or drawings.

1. Wire and Cable
   a. Conductor material
   b. Conductor gage or MCM
   c. Solid or stranded conductor
   d. Insulation material
   e. Insulation type designation
   f. Insulation temperature rating.

2. Wiring Connectors
   a. Connector Type
   b. Connector material
   c. Voltage, amperage and temperature ratings
   d. Conductor size ranges
   e. Tools required
   f. Picture of connector and tools
   g. Manufacturers installation instructions

3. Heat Shrink Material
   a. Type of material
   b. Wall thickness
   c. Voltage, and temperature ratings
   d. Conductor size ranges
   e. Tools required
   f. Picture of material and tools
   g. Manufacturer's installation instructions

4. Insulating Tape
   a. Type of material

b. Thickness and width

5. Wire Pulling Lubricants
   a. Type of material
   b. Types of conductor, insulation and conduit for which it is approved.

B. Megger Test Reports: Indicate values obtained.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Codes and Standards.

1.5 PROJECT RECORD DOCUMENTS

A. Refer to Section 16010.

B. Record actual wire and cable sizes on riser or single line diagrams or floor plans. Record actual circuit numbers by fixture and devices and on circuit homeruns.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with codes and standards listed in Section 16010.

B. Wire shall be manufactured within 12 months prior to the date of delivery to the site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacturing of the products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and

indicated. Products shall bear the UL Label.

1.9 PROJECT CONDITIONS

A. Conductor sizes are based on 75 Degree C copper unless otherwise indicated.

B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.10 COORDINATION

A. Coordinate wire and cable sizes with actual installed equipment.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Manufacturers
1. American Electric
2. Capitol Wire and Cable
3. Condumex Inc.
4. Diamond Wire
5. General Cable
6. Southwire
7. Triangle Wire

B. BUILDING WIRE AND CABLE

1. Description: Single conductor insulated wire.

2. Conductor: Copper; 98 percent conductivity; solid for 10 AWG or smaller; stranded for larger than 10 AWG as applicable.

3. Insulation Thermoplastic; 600 volts, NFPA 70, Type THW TW THHN/THWN unless otherwise indicated; 75 degree C or 90 degree C.

4. Identification

a. General: All wires shall be identified as required by NEC.
b. The insulation on wiring #8 or smaller shall have factory-colored insulation. For wire larger than #8, color coding shall be colored tape wrapped around the insulation of each wire at each connection, splice and pull box. Each phase conductor of each branch circuit shall be of one color throughout the installation.
c. Color coding shall be as follows:
1) 480/277 volt; three phase system:
Phase A - Brown
Phase B - Orange
Phase C - Yellow

Neutral - Gray
Ground - Green
Isolated Ground - Green/Yellow

2) 208/120 volt, three phase system:
Phase A - Black
Phase B - Red
Phase C - Blue
Neutral - White
Ground - Green
Isolated Ground - Green/Yellow

3) 240/120 volt, single phase system:
Phase A - Black
Phase B - Red
Neutral - White
Ground - Green
Isolated Ground - Green/Yellow

C. CONTROL WIRE

1. Description: Single conductor insulated wire.
2. Conductor: Copper; stranded for all sizes.
3. Insulation: Thermoplastic; 600, NFPA 70 Type MTW unless otherwise indicated; 75 degree C or 90 degree C as applicable.
4. All control wire shall be of the same manufacturer.
5. Identification: Control wire shall be color coded throughout. Each wire shall be identifeid at each terminal and junction point by permanently attached wire markers indicating the terminal number, etc. Refer to Section 16195.

2.2 WIRING CONNECTORS

A. Solderless Spring-Wire Connectors: Tool-Applied, twist-on type with plastic caps; Rated for conductor sizes and material.

1. Manufacturers
   a. Buchanan-"B-Cap"
   b. Ideal- "Wing Nut"
   c. ITT Blackburn-"Free Spring"

d. 3M - "Scotchlok"
e. Panduit - "P-Conn"
f. Thomas & Betts "Piggy"
g. Approved equal.

B. Compression Connectors and Taps: Mechanical set screw type or tool-applied crimp type. Split bolt connectors are not acceptable.

1. Manufacturers
a. Blackburn
b. Buchanan
c. Burndy
d. Ilsco
e. Ideal
f. Thomas & Betts
g. Approved equal

2.3 ACCESSORIES

A. Heat Shrink Material: heavy wall tubing or caps; UL Listed as waterproof.

1. Manufacturers
a. Ideal
b. Panduit
c. Raychem
d. 3M
e. Thomas & Betts
f. Approved equal

B. Insulating Tape: Vinyl type; minimum 7 mil; listed for use as primary insulation and splice jacketing on 600 volt wire and cable.

1. Manufacturers
a. Plymouth - Premium III
b. 3M - Scotch 33+
c. Approved equal

C. Wire Pulling Lubricants: Compatible with all conductor,

insulation and conduit types.

1. Manufacturers
    a. American Polywater
    b. Buchanan
    c. Condux
    d. CRC Chemicals
    e. Ideal
    f. Madison
    g. Approved equal

PART 3 EXECUTION

3.1 PREPARATION

A. Completely and thoroughly swab raceway where moisture and/or dirt has collected inside before installing wire.

B. Do not install wire in conduit, raceways, etc. until they are complete and sealed against the entry of moisture and/or debris.

3.2 WIRING METHODS

A. Concealed Dry Interior Locations: Use only building wire, Type TW THW THHN/THWN insulation or as indicated, in raceway.

B. Exposed Dry Interior Locations: Use only building wire, Type TW THW THHN/THWN insulation, in raceway.

C. Above Accessible Ceilings: Use only building wire, Type TW THW THHN/THWN insulation, in raceway.

D. Wet or Damp Interior Locations: Use only building wire, Type TW THW THHN/THWN insulation or as indicated, in raceway.

E. Exterior Locations: Use only building wire, Type TW THW THHN/THWN insulation, in raceway.

F. Underground Installations: Use only building wire, Type TW THW THHN/THWN insulation, in raceway.

G. Remote control, alarm and signal circuits: Type MTW insulation in raceway.

H. Use wiring methods in accordance with the appropriate article of NFPA 70.

I. Connect each circuit of a multi-circuit home run to a different phase.

J. Do not terminate more than one conductor in a single terminal of a lug or connector.

K. Leave slack conductor at each connection and splice to allow for future additional connections.

3.3 INSTALLATION

A. Install products in accordance with the codes and standards herebefore specified and manufacturers instructions.

B. Install all wiring in raceways unless otherwise indicated.

C. Use conductor not smaller than 12 AWG for power and lighting circuits.

D. Use conductor not smaller than 14 AWG for control circuits.

E. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 23 m to the furthest outlet.

F. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 61 m to the furthest fixture.

G. Pull all conductors into raceway at same time.

H. Use suitable wire pulling lubricant.

I. Use a pulling means such as tape, rope, grips, etc. that will not damage the wire, cable or conduit.

J. Neatly train and lace wiring inside boxes, equipment, cabinets, switchboards, and panelboards with nylon tie straps. Three phase circuits shall be grouped by circuit.

K. Clean conductor surfaces before installing lugs and connectors.

L. Make splices,taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

M. Tighten set screws and bolts on connectors according to the manufacturer's torquing requirements.

N. Use compression connectors for copper conductor splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of the conductor.

O. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

P. Where splices and taps are made in junction boxes or hand holes, etc. below grade use tool applied crimp type

compression connectors. Insulate the conductors and the connector with heavy wall heat shrink material.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 16195.

B. Refer to Section 16130 for identification of contents of pull and junction boxes.

C. In pull or junction boxes where there is more than one circuit, identify each conductor with its circuit number or other designation indicated on Drawings.

3.5 WIRING TEST

A. Measure the insulation resistance of all feeder conductors using a "Megger". The test voltage shall be 500 volts. Test the conductor without circuit loads applied. The minimum resistance value shall be 1,000,000 ohms.

3.6 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01440.

B. Inspect wire for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor.

END OF SECTION

SECTION 16130

BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall and ceiling outlet boxes.

B. Floor boxes.

C. Pull and junction boxes.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical.

B. Section 16111 - Conduit.

C. Section 16123 - Building Wire and Cable.

D. Section 16140 - Wiring Devices.

E. Section 16170 - Grounding and Bonding.

F. Section 16180 - Equipment Wiring Systems.

G. Section 16190 - Supporting Systems.

H. Section 16195 - Electrical Identification.

I. Section 16721 - Fire Alarm System.

J. Section 16726 - Intrusion Detection Syst.

K. Section 16741 - Interior Telephone and Data, Pathways and Wiring.

1.3 CODES AND STANDARDS

A. NECA - Standard of Installation.

B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA 70 - National Electrical Code.

F. UL 514A - Metallic Outlet Boxes, Electrical.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different type of outlet, floor, pull and junction box. The information shall be in the form of manufacturer's standard data sheet or drawings or shop drawings.

1. Box material
2. Wall or sheet metal thickness
3. Dimensions
4. Hub or knockout sizes
5. Gasket material
6. Cover plate material and thickness
7. Picture of the box.

1.5 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Data: Submittal data sheets or drawings.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in Section 16010.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated. Products shall bear the U.L. Label.

1.9 PROJECT CONDITIONS

A. Verify locations of floor boxes and outlets prior to rough-in.

B. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

C. Refer to Sections 16010 and 16180.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Manufacturers

1. Appleton
2. Crouse-Hinds
3. Killark
4. O-Z/Gedney
5. Raco
6. Steel City
7. Thepitt
8. Approved equal

B. Sheet Metal Outlet Boxes: galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include male fixture studs where required.

2. Boxes cast in concrete not in contact with earth: Concrete type.

C. Cast Boxes: Type FD cast malleable iron or copper-free aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

D. Wall Plates: Refer to Section 16140.

Modular Design System

2.2 FLOOR BOXES

A. Manufacturers

1. Hubbell
2. Raco
3. Steel City
4. Thomas and Betts
5. Walker
6. Approved equal

B. Floor Boxes: fully adjustable with leveling screws and adjusting rings.

C. Material: Cast metal or Formed steel.

D. Shape: Rectangular.

E. Conform to regulatory requirements for concrete-tight floor boxes.

F. Service Fittings: Refer to Section 16140.

2.3 PULL AND JUNCTION BOXES

A. Manufacturers

1. Appleton
2. Crouse Hinds
3. Hoffman
4. Hope
5. Keystone
6. O-Z/Gedney
7. Queen
8. Approved equal

B. Sheet Metal Boxes: NEMA 1 or as indicated, galvanized steel.

C. Hinged Enclosures: Refer to Section 16160.

D. Surface-Mounted Cast Metal Box: NEMA, Type 4; flat-flanged,

surface-mounted junction box.

1. Material: Galvanized cast iron or cast aluminum.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

E. In-Ground Cast Metal Box: NEMA, Type 6, outside flanged, recessed cover box for flush mounting where indicated.

1. Material: Galvanized cast iron.

2. Cover: Galvanized cast iron cover with neoprene gasket and stainless steel cover screws. Cover shall be smooth for below grade applications and nonskid for flush mounted applications.

3. Cover Legend: As indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install boxes in accordance with NECA Standard of Installation and appropriate article of NFPA 70.

B. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. Inaccessible Ceiling Areas: Install outlet, pull and junction boxes no more than 150 mm from ceiling access panel or from removable recessed luminaire.

F. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods

under the provisions of Section 07270.

G. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

H. Use flush mounting outlet boxes in finished areas.

I. Do not install flush mounting boxes back-to-back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic and fire rated walls.

J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

K. Use stamped steel bridges to fasten flush mounting outlet box between studs.

L. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

M. Use adjustable steel channel fasteners for hung ceiling outlet box. Channel fasteners shall be attached to the main runners or supports. The fastener shall be secured to the tee bar or ceiling support with a screw run thru the tee bar or support and the fastener at each point at which it is attached.

N. Do not fasten boxes to ceiling support wires.

O. Support boxes to or from the structure independent of conduit, except cast outlet boxes that are connected to two rigid metal conduits both supported within 300 mm of box.

P. Use gang box where more than one device is mounted together. Do not use sectional box.

Q. Use gang box with plaster ring for single device outlets.

R. Use cast outlet box in exterior locations exposed to the weather and wet locations.

S. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

T. Set floor boxes level.

U. Large Pull Boxes: Boxes larger than 100 cubic inches 1 600 cubic centimeters in volume or 300 mm in any dimension.

1. Interior Dry Locations: Use box with hinged cover or enclosure under provisions of Section 16160.

2. Other Locations: Use surface-mounted cast metal box.

V. All pull boxes and junction boxes shall be identified as to their contents. Boxes for power feeder and branch circuit wiring shall indicate the circuit numbers. Boxes for communication and control wiring shall indicate the system or what the wiring is for. The identification shall be written on the cover in bold characters using a wide tip, black, permanent marker.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of outlet box for equipment furnished under other Sections. Refer to Section 16180.

B. Coordinate locations and sizes of required access doors with Section 08305.

C. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

D. Coordinate mounting heights of outlet boxes with the device mounting heights indicated on the drawings.

E. Orient boxes to accommodate wiring device orientation.

F. Align adjacent wall mounted boxes for switches, thermostats and similar devices.

G. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

H. Position outlet boxes to locate light fixtures as shown on reflected ceiling plan.

I. Coordinate with architectural, structural and mechanical so that boxes will be accessible.

J. Provide access panels for junction or pull boxes above inaccessible ceilings or in chases.

3.3 ADJUSTING

A. Adjust floor box flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closure in unused box opening.

3.4 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish where scratched or marred.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Device plates and box covers.

E. Photocell switches.

F. Time switches.

G. Occupancy Sensors

H. Sail Switch

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions

B. Section 16112 - Surface Raceways

C. Section 16123 - Building Wire and Cable

D. Section 16130 - Boxes

E. Section 16170 - Grounding and Bonding

F. Section 16180 - Equipment Wiring Systems

G. Section 16195 - Electrical Identification

1.3 CODES AND STANDARDS

A. NECA - Standard of Installation.

B. NEMA WD 1 - General Requirements for Wiring Devices.

C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.

D. NFPA 70 - National Electrical Code.

E. UL 20 - General-use Snap Switches

F. UL 498 - Attachment Plugs and Receptacles

G. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control.

H. UL 917 - Clock Operated Switches.

I. UL 943 - Ground-Fault Circuit Interrupters

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different device. The information shall be in the form of manufacturer's standard data sheets.

1. Wall switches:
   a. Grade
   b. Number of poles
   c. 3 or 4 way
   d. Body and handle material
   e. Color of handle
   f. Voltage rating
   g. Ampere rating
   h. Dimensioned picture of the swtich

2. Wall Dimmers:
   a. Type of circuitry of dimming, RFI filtering and voltage compensation.
   b. On-off switch
   c. Slide control

d. Materials for dimmer, plates, etc.
e. Color
f. Voltage rating
g. Wattage rating
h. Dimensioned picture for the dimmer

3. Receptacles
a. Grade
b. Number of poles and wires
c. Grounding type
d. Material for body and face
e. NEMA configuration
f. Voltage rating
g. Amperage rating
h. Dimensioned picture of the receptacle

4. Photocell Switches
a. Light sensor type.
b. Housing type
c. Temperature range
d. Time delay switch type
e. Number and ratings of contacts
f. Footcandle on/off ratings

5. Time Switches
a. Dial type
b. Day omitting
c. Override
d. Number and rating of switch contacts
e. Carry over provisions
f. Enclosure type

6. Occupancy Sensors
a. Wattage ratings
b. Voltage ratings
c. Electronic ballast compatibility
d. Sensor type
e. Field of view limits
f. Time-out delay ranges
g. Ambient light ranges
h. Off/auto switch

i. LED status indicator
j. Wall plate type
k. Listings
l. Color
m. Adjustment tools
n. Control box inforamtion
o. Installation and adjustment instructions

7. Sail Switch
a. Switch type and ratings
b. Physical dimensions

1.5 PROJECT RECORD DOCUMENTS

A. Refer to Section 16010.

B. Record the location of all devices and the actual circuits to which they are connected.

1.6 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance Data: Submittal data sheets.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standards listed in Section 16010.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Provide Products listed and classified by Underwriters

Laboratories, Inc., as suitable for the purpose specified and indicated. Products shall bear the UL Label.

1.10 FIELD MEASUREMENTS

A. The locations of devices indicated on the drawings are approximate. Coordinate the exact location with millwork and equipment.

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:
1. Bryant 4900 Series
2. Hubbell 1220 Series
3. Arrow-Hart 1990 Series

B. Description: Specification Grade, AC only general-use snap switch; single or double pole, 3 or 4 way as indicated.

C. Body and Handle: plastic with toggle handle. Handle color as indicated.

D. Ratings:
1. Voltage: 120-277 volts, AC.
2. Current: 20 amperes.

2.2 WALL SWITCH WITH PILOT LIGHT

1. Arrow-Hart - 1990 Series
2. Bryant - 4900 Series
3. Hubbell 1220 Series
4. Approved equal

A. Description: Heavy-Duty AC only general-use snap switch; single or double pole as indicated.

B. Body and Handle: Plastic with red toggle handle.

C. Indicator Light: Separate pilot strap with red color lens.

D. Ratings:
   1. Voltage: 120-277 volts, AC
   2. Current: 20 amperes

2.3 20A, DUPLEX RECEPTACLE

A. Manufacturers:
   1. Arrow-Hart - 5362
   2. Bryant - 5362
   3. Hubbell - 5362
   4. Approved equal

B. Description: Specification Grade, 2 pole, 3 wire, grounding type duplex receptacle.

C. Device Body: Plastic with nylon face. Color as indicated.

D. Configuration: NEMA 5-20R

E. Ratings
   1. 125 volts AC
   2. 20 amperes

2.4 GROUND FAULT INTERRUPTER RECEPTACLES

A. Manufacturers:
   1. Arrow-Hart - GF 5342 Series
   2. Bryant - GFR 53FT Series
   3. Hubbell - 5362 Series
   4. Approved equal

B. Description: Specification Grade, 2 pole, 3 wire, grounding type, duplex receptacle, 5 ma sensitivity, feed thru type, test and reset buttons.

C. Device Body: Plastic with plastic or nylon face. Color as indicated.

D. Configuration: NEMA 5-20R

E. Ratings

Modular Design System

1. 125 volts AC
2. 20 Amperes

2.5 20A SINGLE RECEPTACLE, 125V

A. Manufacturers:
1. Arrow-Hart - 5361
2. Bryant - 5361
3. Hubbell - 5361
4. Approved equal

B. Description: Specification Grade, 2 pole, 3 wire, grounding type, simplex receptacle.

C. Device Body: Plastic with nylon face. Color as indicated.

D. Configuration: NEMA 5-20R

E. Ratings
1. 125 volts AC
2. 20 Amperes

2.6 20A HEAVY DUTY RECEPTACLE

A. Manufacturers:
1. Arrow-Hart - 5461 Series
2. Bryant - 5461 Series
3. Hubbell - 5461 Series
4. Approved equal

B. Description: Heavy duty, 2 pole, 3 wire grounding type simplex receptacle.

C. Device Body: Plastic with brown nylon face.

D. Configuration: NEMA 6-20R

E. Ratings
1. 250 volt AC
2. 20 Amperes

2.7 28 Volt DC Receptacle

A. Manufacturers:

1. Bryant - 556 Series
2. Hubbell - 5552-B Series
3. Approved equal

B. Description: Heavy duty, 2 pole, 2 wire simplex receptacle.

C. Device Body: Black or brown phenolic.

D. Configuration: NEMA 2-20R.

E. Ratings
1. 250 volts DC
2. 20 amperes

2.8 WALL PLATES

A. Interior Cover Plate: 302 Smooth satin finish stainless steel with beveled edges or raised stamped steel as indicated.

1. Manufacturer
a. Bryant
b. Hubbell
c. Arrow-Hart
d. Approved equal

B. Weatherproof Cover Plate: Gasketed cast aluminum with hinged gasketed self closing device cover designed to fit over a type FS outlet box. All springs, screws and other hardware shall be stainless steel. The plate shall be UL Listed for wet locations with the cover closed.

1. Manufacturer
a. Bryant
b. Hubbell
c. A-H
d. Approved equal

C. Flush Cover Convenience Receptacle Coverplate:

1. Manufacturer:
   a. Hubbell - S3825 Series
   b. Steel City - P64DS Series
   c. Walker - 828R Series
   d. Approved equal

2. Description:
   a. Material: Brass
   b. Configuration: duplex flap openings.
   c. Carpet Flange: Brass
   d. Hardware: Brass

D. Flush Cover Telephone or Data Outlet Coverplate:

1. Manufacturer:
   a. Hubbell - S3825 Series
   b. Steel City - P64DS Series
   c. Walker - 828R Series
   d. Approved equal

2. Description:
   a. Material: Brass.
   b. Configuration: Duplex flap openings.
   c. Carpet Flange: Brass
   d. Hardware: Brass

E. Flush Cover Plate for Conduit Connection

1. Manufacturer:
   a. Hubbell - S6225 Series
   b. Steel City - P64-1 Series
   c. Walker - 8296K-1 Series
   d. Approved equal

2. Description:
   a. Material: Brass.
   b. Configuration: 1 inch NPS threaded opening with plug.
   c. Carpet Flange: Brass

d. Hardware: Brass

2.9 PHOTOCELL SWITCHES:

A. Manufacturers:
1. Hubbell - PTA Series
2. Intermatic - K4100 Series
3. Paragon - CW Series
4. Tork - 2101 Series
5. Zenith - 9121 Series
6. Approved equal

B. Description:
1. Cadmium sulphide light sensor.
2. Weatherproof diecast aluminum or polycarbonate housing with a Ultrasonic welded lexan or hermetically sealed glass sensor window, and threaded stem, nut and gasket.
3. Temperature range: -30 degrees F to + 140 degrees F.
4. Bimetal time delay switch.
5. Contacts shall be SPST snap action type rated for a minimum of 1800 watts for tungsten laods at 120 volts.
6. Adjustable from approxiamtely 1 to 5 foot candles "on" to approximately 3 to 15 foot candles "off".

2.10 TIME SWITCHES:

A. Manufacturers:
1. Intermatic - V45000 Series
2. Paragon - 4200 Series
3. Tork - 7000 Series
4. Approved equal

B. Description:
1. Astronomical dial
2. Day omitting
3. Manual override switch
4. Switch type: minimum 40 amp, 277 volt, DPST.
5. Spring wound carry-over to maintain operation for a minimum of 10 hours during a power outage.
6. Enclosure: code gage steel, NEMA 1 enclosure with manufacturer's standard enamel finish.

7. Mount enclosure with a minimum of four bolts. Refer to Section 16190.

2.11 OCCUPANCY SENSOR-WALL SWITCH TYPE

A. Manufacturers:
1. Bryant
2. Honeywell
3. Leviton
4. Pass and Seymor
5. Watt Stopper
6. Approved equal

B. Description:
1. Rated for both incandescent and fluorescent lamps; 500 to 1200 watts minimum at 277 volts.
2. Compatible with electronic fluorescent ballasts.
3. Passive infrared type sensor.
4. Minimum 170 degree field of view with an adjustable range of 20 to 40 feet straight ahead, a minimum of 20 feet to either side and a coverage area of up to 2600 square feet.
5. Adjustable time-out delay, 2 to 12 minutes minimum with adjusting dial concealed behind a cover plate.
6. Adjustable ambient light sensor, 10 footcandles to full daylight minimum with adjusting dial concealed behind a cover plate.
7. Off/auto selector switch accessible thru the front cover.
8. LED control status indicator
9. Fits in a standard single gang outlet box.
10. Wall plate shall be the same as hereinbefore specified.
11. UL Listed
12. Meets California Title 24 requirements.
13. ivory color.

C. If adjustment tools are required for the unit, provide three spare tools.

D. Install and adjust time-out delay and ambient light settings for the sensor in accordance with the manufacturer’s instructions.

2.12 OCCUPANCY SENSOR-CEILING TYPE

A. Manufacturers:
   1. Bryant
   2. Honeywell
   3. Leviton
   4. Pass and Seymor
   5. Watt Stopper
   6. Approved equal

B. Description:
   1. Passive infrared type sensor.
   2. 360 degree field of view.
   3. Adjustable time-out delay, 2 to 12 minutes minimum.
   4. Adjustable ambient light sensor, 10 footcandles to full daylight minimum.
   5. Integral circuit relay or separate control unit.
   6. Compatible with electronic ballasts.
   7. Rated for both incandescent and fluorescent lamps; 1000 watts to 2500 watts minimum at 277 volts
   8. Retaining device mounting the sensor in the ceiling.
   9. UL Listed
   10. Meets California Title 24 requirements.

C. If adjustment tools are required for the unit, provide three spare tools.

D. Install and adjust time-out delay and ambient light settings for the sensor in accordance with the manufacturer’s instructions.

2.13 SAIL SWITCH

A. Manufacturers:

   1. Honeywell
   2. Johnson Controls
   3. Robertshaw
   4. Approved equal

B. Description:

Modular Design System

1. SPST mercury switch with sail which extends into the ductwork for direct measurement of air flow.
2. Three amp rating at 120 volts.
3. Switch makes an increase in air velocity.
4. Designed for vertical duct mounting
5. Operating air velotic y 182 m/minute minimum.
6. Metal case with conduit fitting.

C. Provide screws, washers, gaskets, etc. for complete installation.

D. Install the switch in accordance with the manufacturer’s instructions.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with NECA "Standard of Installation", NFPA 70 and manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

E. Do not share neutral conductor on load side of dimmers.

F. Install receptacles with grounding pole on bottom.

G. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

H. Install plates on switch, receptacle, and blank outlets in finished areas.

I. Connect wiring devices by wrapping conductor around screw terminal.

J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

K. Install protective rings on flush cover service fittings.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights indicated on drawings.

3.3 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.4 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.5 CLEANING

A. Clean debris from outlet, and floor boxes and service fittings.

B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hinged cover enclosures.

B. Cabinets.

C. Accessories.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical

B. Section 16111 - Conduit

C. Section 16123 - Building wire and Cable

D. Section 16130 - Boxes

E. Section 16170 - Grounding and Bonding

F. Section 16180 - Equipment Wiring Systems

G. Section 16190 - Supporting Devices

H. Section 16195 - Electrical Identification

I. Section 16741 - Interior Telephone, Pathways, and Wiring

1.3 CODES AND STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each cabinet and enclosure. The information shall be in the form of manufacturer's standard data sheets or drawings.
1. NEMA Rating
2. Metal gage backbox, cover and trim.
3. Mounting type
4. Mounting provisions for terminal blocks, etc.
5. Dimensions
6. Type of latch, lock and hinges
7. Type and color of finish

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 PROJECT RECORD DOCUMENTS

A. Refer to Section 16010.

B. Record the actual locations of cabinets and enclosures with their designations.

1.6 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance Data: Submittal data sheets on cabinets and enclosures.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in Section 16010.

1.8 QUALIFICATIONS

Modular Design System

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated. Products shall bear the U.L. Label.

1.10 MAINTENANCE MATERIALS

A. Provide two of each cabinet key.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Austin

B. Hammond

C. Hoffman

D. Keystone

E. Queen Products

F. Robroy

G. Approved equal

2.2 HINGED COVER ENCLOSURES

A. Construction: steel enclosure; NEMA Type as indicated.

B. Size: As indicated.

C. Covers: Gasketed steel with continuous hinge, held closed by

flush latch operable by key to match branch circuit panelboard.

D. Mounting: as indicated.

E. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

F. Knockouts: None

G. Enclosure Finish: Manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install enclosures and boxes plumb. Anchor securely to wall, floor and structural supports at each corner. See Section 16190.

C. Install cabinet fronts plumb.

D. Identify the contents of the enclosure or cabinet with a laminated plastic nameplate engraved with 13 mm minimum height characters. The nameplate shall be white with black characters and securely attached to the outside front of the enclosure or cabinet.

END OF SECTION

SECTION 16170

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

1.2 RELATED SECTIONS

A. All Division 16 Sections.

1.3 CODES AND STANDARDS

A. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedence, and Earth Surface Potentials of a Ground System.

B. NFPA 70 - National Electrical Code.

C. UL 467 - Electrical Grounding and Bonding Equipment

D. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors.

1.4 GROUNDING ELECTRODE SYSTEM

A. Metal frame of the building.

B. Ground ring (counterpoise).

C. Rod electrode.

1.5 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 10 ohms maximum.

1.6 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different item. The information shall be in the form of manufacturer's standard data sheets.

1. Rod Electrods
   a. Rod material
   b. Dimensions
   c. Coupling type
2. Mechanical Connectors
   a. Material
   b. Connector type
3. Exothemic Connections
   a. Process description
   b. Mold types
   c. Weld material
   d. Starting material
4. Grounding Well
   a. Dimensioned picture or drawing of gorunding well and cover.
   b. Well pipe material.
   c. Well cover material and legend.

B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.7 PROJECT RECORD DOCUMENTS

A. Refer to Section 16010.

B. Accurately record actual locations of grounding electrodes, counterpoise, test wells and other inground items. Dimension location from exterior walls and corners of the building.

C. Record location of ground connections for transformers,

service equipment and building steel.

1.8 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance Data: Submittal data sheets.

1.9 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in SEction 16010.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.11 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated. Products shall bear the UL Label.

PART 2 PRODUCTS

2.1 ROD ELECTRODE

A. Manufacturers:

1. Apache
2. Galvan
3. ITT Blackburn
4. Approved equal

B. Material: Copper-clad steel with high-strength steel core and electrolytic grade copper outer sheath, molten welded to the core with tapered point and threaded ends.

Modular Design System

C. Diameter: 19 mm.

D. Length: 3 m per section.

E. Couplers: Exothermic welds

2.2 MECHANICAL CONNECTORS

A. Direct buried and Exposed Connectors

1. Manufacturers:
   a. Burndy
   b. Ilsco
   c. ITT Blackburn
   d. Thomas & Betts
   e. Approved equal

2. Material: Bronze; mechanical set screw or bolt type or tool applied crimp type. Split bolt connectors are not acceptable.

B. Connectors in Enclosures, Boxes, etc.:
1. Refer to Section 16123.

2.3 EXOTHERMIC CONNECTIONS

A. Manufacturers:
1. Burndy
2. Erico Products Inc.
3. Approved equal

B. Description:

1. Process: Exothermic process that produces molecular bonding of connected items.
2. Approved for exposure or direct burial without degradation.
3. Use graphite molds of proper size and design for the weld and connected items.
4. Weld material: Copper oxide and aluminum mixture with a minimum 3 percent tin.

5. Starting material: Aluminum, copper and iron oxides ignited only by spark ignitor designed for the purpose.
6. Miscellaneous: provide tools and other devices required for a complete weld.
7. All welding materials shall be of the same manufacturer.

2.4 WIRE

A. Material: Copper, 98 percent conductivity; insulated copper for all feeders, branch circuits; bonding jumpers and transformer grounds; solid for 10 AWG and smaller, stranded for larger than 10 AWG. See Section 16123 for insulation types.

B. Foundation Electrodes: Bare, tinned, stranded copper 1/0 AWG.

C. Grounding Electrode Conductor: Insulated copper; size as indicated.

D. Counterpoise: Bare, Tinned stranded, copper, 1/0 AWG.

2.5 GROUNDING WELL COMPONENTS

A. Well Pipe: Concrete well with belled end.

B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.6 STATIC GROUNDING RECEPTACLE

A. Manufacturers
1. Burndy - YTTAG Series
2. Cadweld - B166 Series
3. Approved equal

B. Description: Flush mounted combination tie-down and static grounding receptacle with 19 mm inch diameter attachment bar, cover and safety chain. The receptacle body, attachment bar and cover shall be made of a copper alloy casting. The

receptacle shall be connected to the ground rod, size as indicated, with an exothermic weld connection.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Install Products in accordance with NFPA 70 and manufacturer's instructions.

B. Ground-exposed, noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems.

C. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground. Locate a minimum of one-rod length from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 610 mm below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Drive rods until tops are 150 mm below finished floor or final grade except as otherwise indicated. Proper driving studs and sleeves shall be used when driving ground rods. Water shall be continuously applied, to the ground at the point where the rod penetrates, during the driving process.

D. Provide grounding well with cover at each rod location indicated. Install well top flush with finished grade.

E. Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment to main metallic water service entrances to the

building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings. Bond the ground conductor conduit to the conductor at each end. Provide supplemental grounding electrode as required by NFPA 70.

F. Install braided-type bonding jumpers to connect ground clamps on water meter piping to bypass water meters electrically.

G. Provide bonding jumpers as required by NFPA 70.

H. Bond together metal siding not attached to grounded structure; bond to ground.

I. Use exothermic welded connections for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and other electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

J. At Test Wells, use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

K. The building structural steel frame shall be grounded to the building service grounding electrode, using the conductor size indicated.

L. Assure the electrical continuity of all metallic raceway systems, pulling up all conduits and/or locknuts wrench tight.

M. Where expansion joints or telescoping joints occur, provide bonding jumpers.

N. Where flexible metallic conduit is employed, provide a green-insulated grounding jumper installed in the flexible conduit.

O. Provide grounding bushings on all service and feeder raceways terminating within switchboards, motor control centers, panelboards, cabinets, and all other enclosures. Provide grounding conductors from such bushings to the frame of the enclosure and to the ground bus or equipment grounding strap.

P. Provide separated isolated grounding conductor within each feeder or branch circuit raceway for circuits where indicated. Refer to Section 16123 for identification.

Q. Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Refer to Section 16123 for identification.

R. Where paralleled conductors in separate raceways occur, provide a grounding conductor in each raceway.

3.3 COORDINATION WITH OTHER SYSTEMS

A. Coordinate connections to and requirements for grounding for site lighting, lightning protection, telephone, alarm and communication systems. Refer to appropriate specification section. All systems shall be bonded together as required by the NFPA 70.

3.4 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

3.5 TESTING

A. The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 10 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than one

rod length on center, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. If the resultant resistance exceeds 10 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations.

END OF SECTION

SAFETY PAYS

Modular Design System

SECTION 16180

EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to Government-furnished equipment and equipment specified under other sections.

1.2 RELATED SECTIONS

A. Division 0 - Contract Requirements.

B. Division 1 - General Requirements

C. Division 11 - Equipment

D. Division 12 - Furnishings

E. Division 14 - Conveying Systems

F. Division 15 - Mechanical

G. 16010 - General Provisions, Electrical

H. 16111 - Conduit

I. 16112 - Surface Raceways

J. 16123 - Building Wire and Cable

K. 16130 - Boxes

L. 16140 - Wiring Devices

M. 16170 - Grounding and Bonding

N. 16190 - Supporting Devices

O. 16195 - Electrical Identification

P. 16441 - Enclosed Switches

Q. 16470 - Panelboards

R. 16477 - Fuses

S. 16481 - Enclosed Motor Controllers

1.3 CODES AND STANDARDS

A. Refer to Section 16010.

B. Specific codes and standards listed in applicable Division 16 sections for equipment, devices, wiring, etc. used for connection to equipment.

1.4 REGULATORY REQUIREMENTS

A. Refer to Section 16010.

1.5 EQUIPMENT CONNECTIONS

A. Contractor shall make connections to Government-furnished equipment and equipment furnished by other sections requiring electrical connections. Provide miscellaneous items such as disconnect switches, starters, plugs, receptacles, boxes, conduit, wire cords, etc. as indicated and required to make the connection.

1.6 CONTROL WIRING

A. Control equipment furnished under this section of the specifications, and shown on the drawings, shall be connected under this section of the specifications unless shown or specified otherwise. Except as otherwise specifically noted, automatic-control wiring, signaling, and protective devices are not included in this section of the specifications, but shall be furnished and installed under other sections of the specifications. Control wiring not shown on the drawings

shall be furnished under the other sections of the specifications.

1.7 COORDINATION

A. Refer to applicable sections of Division 1.

B. Obtain and review shop drawings, rough-in drawings, product data, and manufacturer's instructions for equipment furnished under other sections to determine connection locations and requirements.

C. Capacities of feeders, motor starters, circuit breakers, switches, protective devices, and other electrical devices indicated to be furnished and installed by the Electrical Section for electrically operated equipment, regardless of who furnishes and/or installs that equipment, are based upon the average horsepower and/or electrical ratings of the types andsizes of the equipment used. Before commencing electrical work for electrically operated equipment, the electrical section shall: check horsepower and/or electrical rating of each individual electrically operated equipment items, regardless of who furnished and/or installs that equipment.

D. Switches, circuit breakers, motor starters, protective devices, and other electrical devices furnished by other Sections and by others for installation and/or wiring by Electrical Section, are specified elsewhere to have adequate capacities to serve the electrically operated equipment which they are furnished. However, BEFORE installing and/or wiring each of these devices, the Electrical Section shall check each individual device's electrical rating with the horsepower and/or electrical rating of the corresponding electrically operated equipment actually installed, regardless of who furnishes and/or installs the devices and equipment. The Electrical Section shall not install and/or wire any device that is found to be the incorrect size. The Contractor shall notify the Resident Officer In Charge of any such discrepancies.

E. Sequence rough-in of electrical connections to coordinate

with installation schedule for equipment.

F. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 PRODUCTS

2.1 GENERAL

A. Equipment, devices, wiring, etc. as required shall be as specified in the appropriate Division 16 section.

2.2 CORDS AND CAPS

A. Plug Configuration: match receptacle configuration at outlet provided for equipment where applicable.

B. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations. Maximum length - 1830 mm.

C. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

2.3 RECEPTACLES

A. Configuration: match configuration for plug provided with equipment where applicable.

PART 3 EXECUTION

3.1 ELECTRICAL CONNECTIONS

A. All electrical outlets, switches, starters, etc. shall be installed in approximately the locations indicated. Adjustments shall be made as required, to avoid interferences with installed equipment, work by other divisions, and structure. Code required clearances shall be maintained around electrical equipment. Electrical equipment shall not be installed as to interfere with the working and maintenance spaces of equipment provided by other sections.

B. Electrical equipment, fixtures, outlets and connections to equipment furnished by others may be moved up to ten feet from the location shown on the drawings without any cost to the owner if the contractor is notified before the electrical work for that item is installed.

C. Electrical equipment, devices, wiring, etc. shall be installed in accordance with the appropriate Division 16 section.

D. Extend wiring to the equipment and make proper connections thereto.

E. Make electrical connections in accordance with equipment manufacturer's instructions.

F. Where indicated, make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations. Flexible conduits with a minimum length of 18 inches or 12 times the diameter of the conduit whichever is greater, shall be provided to all equipment subject to periodic removal, vibration, or movement and for all motors.

G. Make connections to motors, not near walls or columns, with a vertical rigid metal conduit, minimum size 21 mm, attached to the floor and ceiling. Wiring shall be carried into and out of this conduit by means of condulets and flexible conduit.

H. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

I. Provide receptacle outlet where connection with attachment plug is indicated. Install the receptacle as close as practicable to the equipment served. Provide cord and cap where field-supplied attachment plug is indicated.

J. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

K. Provide interconnecting conduit and wiring between devices and equipment where indicated.

L. Motors: All motors shall be provided with separate grounding conductors.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel channel for conduit and equipment supports.

B. Anchors and fasteners.

C. Spring steel clips

D. Hangers, Clamps and fittings.

E. Cable tray hangers.

F. Cable ties

1.2 RELATED SECTIONS

A. All Division 16 Sections.

1.3 CODES AND STANDARDS

A. NECA - Standard of Installation

B. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Product Data: Provide manufacturer's standard catalog data for fastening and support devices and channel.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, and preparation, installation, of the Product.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in Section 16010.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated. Products shall bear the UL Label.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.

B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

C. Anchors and Fasteners:

1. Concrete Structural Elements: Use precast insert system, expansion anchors, powder actuated anchors and preset inserts as applicable.
2. Steel Structural Elements: Use beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners as applicable.
3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions:

Use toggle bolts and hollow wall fasteners.

5. Solid Masonry Walls: Use expansion anchors and preset inserts.
6. Sheet Metal: Use sheet metal screws.
7. Wood Elements: Use wood screws.

2.2 STEEL CHANNEL

A. Manufacturer:
1. Allied
2. B-Line
3. Kindorf
4. Superstrut
5. Unistrut
6. Approved equal

B. Description: 14 gauge minimum Galvanized or Painted steel with factory punched attachment holes. Nuts, bolts, straps and other accessories shall be designed for use with the channel.

2.3 SPRING STEEL CLIPS

A. Manufacturer:

1. B-Line
2. Erico
3. Approved equal

2.4 HANGERS, CLAMPS AND FITTINGS

A. Manufacturer:

1. Allied
2. B-Line
3. Kindorf
4. Superstrut
5. Unistrut
6. Approved equal

Modular Design System

B. Description: Galvanized steel.

2.5 CABLE TIES

A. Manufacturer:

1. 3M
2. Ideal
3. Panduit
4. Thomas & Betts
5. Approved equal

B. Description: One piece, nylon.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with NFPA 70 and the manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

D. Do not use tie wire, perforated pipe straps or nylon ties to support conduits.

E. C-clamps or beam clamps shall have strap or rod-type retainers.

F. Raceways or pipe straps shall not be welded to steel structures.

G. In partitions of light steel construction, sheet-metal screws may be used.

H. Load applied to fasteners shall not exceed one-fourth test

load.

I. Fasteners attached to concrete ceiling shall be vibration-resistant and shock-resistant.

J. Where raceway, boxes and equipment is supported on gypboard and studwalls, vertical and horizontal bracing in the wall shall be provided to support the weight of the raceway, etc. and to receive the screws.

K. Obtain permission from Architect/Engineer before drilling or cutting structural members.

L. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

M. Install surface-mounted cabinets and panelboards with minimum of four anchors.

N. In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm off wall.

O. Provide cable hangers as indicated on the drawings for all cables that are allowed to be run without conduit. The hangers shall consist of typical 100 mm straight J-hook pipe hangers secured to each stud on 910 mm centers with standard sheetrock screws of length required to penetrate and secure to the stud. There shall be 3 rows of these hooks along the corridor walls indicated.

Where crossing from one side of the corridor to the other or across open spaces, vertical and horizontal supports as required shall be provided to support the hooks. Where ducts and pipes are encountered, the hooks may be separated to allow cables to be routed above and below the duct and pipes.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Identification Plates.

B. Wire and cable markers.

C. Underground Utility Warning tape.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical

B. Section 16123 - Building Wire and Cable.

C. Section 16160 - Cabinets and Enclosures

D. Section 16441 - Enclosed Switches

E. Section 16461 - Dry Type Transformers

F. Section 16470 - Panelboards

G. Section 16476 - Enclosed Circuit Breakers

H. Section 16481 - Enclosed Motor Controllers

I. Section 16485 - Contactors

J. Section 16721 - Fire Alarm System

K. Section 16726 - Intrusion Detection System

L. Section 16741 - Interior Telephone and Data, Pathways, and Wiring

Modular Design System

1.3 CODES AND STANDARDS

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Product Data: Provide manufacturer's standard catalog data for nameplates, and markers.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

A. Engraved, Plastic-Laminated Identification Plates: Engraving stock melamine plastic laminate, 1.6 mm minimum thick for signs up to 12,500 square mm, or 200 mm in length; 3 mm thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners. Edges shall be chamfered. Plates shall be fastened with black-finished round-head screws or rivets, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location.

Modular Design System

B. Locations:

1. Refer to each related section for detailed information about plate locations and wording.

C. Letter Size:

1. Use 6 mm letters for identifying individual equipment and loads.
2. Use 12 mm letters for identifying grouped equipment and loads.
3. Use 12 mm letters for identifying Panelboards and cabinets.

2.2 WIRE AND CABLE MARKERS

A. Wire and cable designation tape markers.

1. Manufacturers:
   a. Seton
   b. Almetek
   c. Thomas and Betts
   d. Panduit
   e. Approved equal

2. Description: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

B. Colored Adhesive Marking Tape

1. Manufacturers
   a. 3M
   b. Plymouth
   c. Thomas and Betts
   d. Approved equal

2. Description: Self-adhesive vinyl tape not less than 7 mils thick by 19 mm to 50 mm in width.

C. Locations: Refer to each related section for detailed information about locations and indications.

2.3 UNDERGROUND UTILITY WARNING TAPE

A. Manufacturers:

1. Seton
2. Thomas & Betts
3. Almetek
4. Panduit
5. Approved equal

B. Description: Minimum 4 mils thick, 150 mm wide composition metallized foil-plastic film laminate, detectable type,

colored red with suitable permanent, continuous-printed, warning legend describing buried electrical lines. Tape shall be formulated for prolonged use underground.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive plates and markers.

3.2 APPLICATION

A. Install identification plates parallel to equipment lines.

B. Install all products in accordance with manufacturer's instructions.

C. Refer to Section 16111 for installation requirements for underground utility warning tape.

END OF SECTION

SECTION 16268

28 VDC POWER SUPPLY/400-HERTZ (HZ) SOLID STATE FREQUENCY CONVERTER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 158-1	Rating and Testing for Contactors

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEEE 519	(1992) Harmonic Control in Electrical Power Systems
IEEE 1100	(1992) Powering and Grounding Sensitive Electronic Equipment (IEEE Emerald Book)
IEEE 1159	(1995) Monitoring Electric Power Quality

MILITARY STANDARDS (MIL-STD)

MIL-STD-461	(Rev. D) Control of Electromagnetic Interference Emissions and Susceptibility
MIL-STD-462	(Rev. D) Electromagnetic Interference Characteristics
MIL-STD-704	(Rev. E) Aircraft Electric Power Characteristics
MIL-STD-1399-300	(Rev. A) Interface Standard for Shipboard Systems Section 300A Electric Power, Alternating Current (Metric)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ST 20	(1992) Dry-Type Transformers for General

Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 489	(1991; Bul. 1992, 1993, 1994, 1995, and 1996, R 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 506	(1994; R 1994, Bul. 1995 and 1996) Speciality Transformers
UL 508	(1993; Bul. 1993 and 1995, R 1996) Industrial Control Equipment
UL 1012	(1994) Safety Power Units Other Than Class 2

1.2 NOT USED

1.3 SUBMITTALS

Submit under provisions of Section 01300. Refer to Section 16010.

1.3.1 Manufacturer's Catalog Data

a. Frequency converter

b. Nameplate ratings for kilowatts (kW), voltage (V), and frequency (Hz)

1.3.2 Drawings

a. Frequency converter

b. Wiring diagram

c. Schematic diagram

d. Power and control external connection diagram

1.3.3 Statements

a. Work plan

b. Routine factory test procedures

c. Special factory test procedures

d. Qualifications of manufacturer

e. Field test procedures

1.3.3.1 Work Plan

Submit a written schedule of dates of factory tests, installation, and

field tests of converter.

1.3.3.2 Routine Factory Test Procedures

Submit 7 copies of test plans and procedures at least 21 calendar days prior to the test being conducted. Provide detailed description of tests procedures, including test equipment and setups, to be used to ensure the converter meets the performance specification and explain the test methods to be used. As a minimum, the tests procedures shall include the tests required under the paragraph entitled "Routine Factory Tests."

1.3.3.3 Special Factory Test Procedures

Submit 7 copies of test plans and procedures. Provide detailed description of tests procedures, including test equipment and setups, used to ensure the converter meets the performance specification and explain the test methods used. As a minimum, the tests procedures shall include the tests required under the paragraph entitled "Special Factory Tests."

1.3.3.4 Qualifications of Manufacturer

Submit a certification that the manufacturer has a minimum of five (5) years' experience in the design, manufacturing, and testing of 400 Hz solid state frequency converters for direct connection to aircraft electrical loads.

The certification shall state that the manufacturer is experienced in manufacturing and testing solid state inverters of a similar kVA rating. Experience in manufacturing motor generator sets does not qualify as equivalent. Experience in manufacturing portable power units on wheels does not qualify. The manufacturer shall be experienced in producing units for installation in permanent buildings in environmentally closed spaces or in weatherproof enclosures as applicable. The manufacturer shall also document that inverters are connected to non-linear loads typically encountered in the aircraft and ship industries. The manufacturer shall furnish maintenance engineering records from Navy shore installations to ensure 24,000 hour mean time between failures (MTBF) requirements. The manufacturer shall furnish documented experience with inverters in various environmental conditions including exterior flight line, hangar, and environmentally enclosed spaces within buildings.

1.3.3.5 Field Test Procedures

Submit 7 copies of test plans and procedures at least 15 calendar days prior to the field tests. Provide detailed description of test procedures, including test equipment and setups, used to ensure the converter meets the performance specification and explain the test methods to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Field Tests and Inspections." Test reports shall include power quality measurement data collected in accordance with IEEE 1159.

1.3.4 Factory Test Reports

a. Routine factory tests report

b. Special factory tests report

c. Burn-in test

1.3.4.1 Routine Factory Tests Report

Submit within 15 calendar days after completion of tests. Certify tests were conducted on each converter in accordance with the requirements set forth in paragraph entitled "Routine Factory Tests" and certify converter satisfactorily operated within specified limits. Report shall include copies of the test procedures and test data and results.

1.3.4.2 Special Factory Tests Report

Certify tests were conducted on a converter of the same design, construction and kVA and voltage rating to be provided and in accordance with the requirements set forth in paragraph entitled "Special Factory Test" and certify converter operated without malfunctioning within specified limits. Report shall include copies of the test procedures and test data and results.

1.3.5 Field Test Reports

a. Frequency converter

Submit within 15 calendar days after completion of tests. Provide in accordance with the requirements set forth in paragraph entitled "Field Tests and Inspections." Certify tests were conducted on each converter in accordance with the paragraph entitled "Field Tests and Inspections" and certify converter satisfactorily operated within specified limits. Report shall include copies of the test procedures and test data and results.

1.3.6 Certificates

a. Routine factory test certification

b. Special factory test certification

c. Burn-in test

1.3.6.1 Routine Factory Test Certification

Submit certification that routine factory tests were conducted on each converter and converter operated within specified limits.

1.3.6.2 Special Factory Test Certification

Submit certification that special factory tests have been conducted on a converter of the same design, construction, and kVA rating to be provided, and that the converter operated within specified limits.

1.3.6.3 Burn-In Test

Submit certification that burn-in test has been conducted in conformance with the paragraph entitled "Routine Factory Tests."

1.3.7 Operation and Maintenance Manuals

a. Frequency converter, Data Package 5

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data." In addition include a "one-line diagram"

from service entrance to 400 Hz utilization panel or point.

1.4 EXTRA MATERIALS

Furnish recommended manufacturer's spare parts list and schedule of prices for each type of converter and other equipment specified in this section. They shall include the following:

a. Power semi-conductors

b. Power filter capacitors

c. Plug-in logic cards

d. Output switching modules

e. Fuses

f. Indicator lamp/LED

PART 2 PRODUCTS

2.1 MANUFACTURERS

a. Magl Power

b. Rapid Power Technologies

c. Approved equal

2.2 400 HZ FREQUENCY CONVERTER

Provide frequency converter consisting of modular construction solid-state components for 60 to 400 Hz conversion, input/output devices, and ancillary control devices. Frequency converter shall be a standard product of the manufacturer and shall be the manufacturer's latest design that complies with the specification requirements. The 400 Hz frequency converters provided shall be products of the same manufacturer. The unit shall have a calculated MTBF exceeding 24,000 hours as calculated when the converter is provided with yearly servicing and maintenance. The converter shall be UL listed to comply with UL 1012. Control components shall be UL 508 listed. The converter shall use a 12 pulse input rectification circuit.

2.2.1 Electrical Characteristics

2.2.1.1 Input Voltage

480Y/277 V, three phase, four wire, grounded, 60 Hz. Converter shall provide rated output voltage when input voltage is varied plus or minus 10 percent. Neutral currents shall not exceed 21 percent of any individual phase current at no load and at full load.

2.2.1.2 Input Voltage Deviation

Input voltage deviation shall be a maximum of 2 percent for all load conditions.

2.2.1.3 Input Power Factor

Between 0.8 and unity, under all conditions of steady state line and load variations specified herein.

2.2.1.4 Surge Protection

The converter shall be capable of sustaining an input surge described in and tested in accordance with IEEE C62.41, location Category B, and continue to operate with no alarms within the specified tolerance.

2.2.1.5 Inrush Current

Measure and record inrush current for the first half cycle (8 to 10 milliseconds). The inrush current shall not exceed 100 percent of the rated full load current. Conduct three tests and provide copies of waveform in test report.

2.2.1.6 Input Current Distortion

For units over 60 kVA through 300 kVA, 10 percent (maximum) THD with nominal input voltage while providing rated output power.

2.2.1.7 Output Voltage

115/200 V, three phase, 400 Hz, grounded system. Adjustable to plus or minus 10 percent of the rated voltage. The limits overvoltage and undervoltage shall be plus or minus 2 percent. The phase rotation of the output voltage shall be clockwise sequence of A-B-C.

2.2.1.8 Power Output

75 kVA at 0.8 power factor lagging.

2.2.1.9 Load Range

Operate into a load with a power factor between 0.5 leading and 0.8 lagging and into a non-linear load with a minimum crest factor for each phase current of 2.0. The crest factor is the ratio of the peak value to the root mean square (RMS) value under steady state conditions].

2.2.1.10 Efficiency

The 75 kVA units shall have a minimum efficiency of 95% at 100% load.

2.2.1.11 No Load Input Losses

The frequency converter shall have no-load input losses no greater than 5 percent of the output kVA rating.

2.2.1.12 Overload/Overcurrent

Satisfactory overload/overcurrent operating time is based on no more than one overload in any 4 consecutive hours of operation:

Percent of Full Load	Satisfactory Operating Time
110 percent	60 minutes
125 percent	5 minutes
150 percent	2 minutes

Percent of Full Load	Satisfactory Operating Time
200 percent	20 seconds
300 percent	6 seconds

2.2.1.13 Short Circuit

When a bolted line-to-ground fault, a bolted line-to-line fault, or a bolted three phase fault is applied to the unit, unit shall be capable of sustaining the short circuit current without damage until the protective device interrupts the fault.

2.2.1.14 Output THD

a. Balanced load:

(1) THD: Not to exceed 2 percent line-to-line and line-to-neutral.

(2) Maximum single harmonic distortion: Not to exceed 1 percent of the fundamental at the nominal voltage.

b. Unbalanced load: THD not to exceed 4 percent, line-to-neutral with 15 percent unbalanced load.

2.2.1.15 Amplitude Modulation

Shall not exceed 1/4 to 1/2 percent no load to full load.

2.2.1.16 Frequency Stability

400 Hz within plus or minus 0.5 percent for all operating conditions, including maximum and minimum specified input voltages, ambient temperature and relative humidity. The frequency regulation shall be independent of load changes.

2.2.1.17 Phase Angle Regulation

Displacement angle between adjacent voltage phases shall be 2.09 rad plus or minus 0.0349 rad with balanced load and plus or minus 0.0698 rad with three phase 15 percent unbalanced load. A 15 percent unbalanced load is defined as:

a. Phase A at full rated single load.

b. Phase B at 85 percent of Phase A.

c. Phase C at 85 percent of Phase A.

2.2.1.18 Transient Output Voltage Recovery

In accordance with MIL-STD-704.

2.2.2 Environmental Rating

The converter shall operate satisfactorily from no load to rated full load under the following conditions:

a. Ambient temperatures ranging from 0 degrees C to 50 degrees C.

b. Relative humidity from 0 to 95 percent noncondensing.

c. Ambient pressures from sea level to 915 meters .

2.2.3 Monitoring and Control Panel

Provide converter with a control panel that is equipped with the following controls, indicators, instrumentation and alarms.

2.2.3.1 Controls

a. Start/stop pushbutton.

b. Lamp/light emitting diode (LED) test - A push-to-test button or switch to test indicator lamps/LEDs.

c. Alarm reset - A pushbutton to silence audible alarms.

d. Emergency power off.

e. Master/slave switch.

f. Output contactor ON/OFF.

g. Output voltage adjust - Locate output voltage control inside converter enclosure, available for adjustment by maintenance personnel only when the door is open.

2.2.3.2 Indicators

a. Input power available - Lamp/LED to indicate that the supply voltage is available.

b. Output power On/Off - Lamp/LED to indicate that the converter output voltage is available.

c. System alarm - Lamp/LED to indicate that a fault has been detected. This indicator shall be latched in the "ON" position whenever an alarm condition described in paragraph entitled, "Alarm Annunciator," is detected and shall remain "ON" until the alarm reset pushbutton is pressed.

d. Indicating lamp/LED to indicate that the alarm silence switch is in the disable position.

e. Audible alarm.

f. Master operation mode - Lamp/LED to indicate that the converter is operating in parallel mode and is operating as the master unit.

g. Slave operation mode - Lamp/LED to indicate that the converter is operating in parallel mode and is operating as a slave unit.

h. Output contactor "ON".

i. Aircraft interlock bypass - Lamp/LED to indicate that the Aircraft Interlock has been bypassed.

2.2.3.3 Instrumentation

a. Elapsed time meters (in hours).

b. Output voltmeter selector switch having three phase-to-phase positions for monitoring delta outputs in accordance with MIL-STD-1399-300, phase to neutral positions for monitoring wye voltage outputs in accordance with MIL-STD-704 and one "OFF" position.

c. Output ammeter selector switch having three phase positions and one "OFF" position.

d. Output frequency meter, 390 to 410 HZ scale, having a 400 HZ center with an ON-OFF switch.

2.2.3.4 Alarm Annunciator

The unit shall be capable of detecting the following abnormal conditions, sounding an audible alarm and illuminating individual indicator lamp/LEDs that are clearly identified:

a. Input overvoltage.

b. Input undervoltage.

c. Output undervoltage.

d. Output overvoltage.

e. Output overload.

f. System alarm.

g. Control logic failure.

h. Frequency deviation.

i. Overtemperature.

j. Logic power supply failure.

2.2.4 Input/Output Devices

Fully-rated, three-pole devices for control of 60 Hz input and 400 Hz output from the converter. Devices and cables operating at 400 Hz shall be derated in accordance with IEEE 519.

2.2.4.1 Circuit Breaker

Conform to requirements of NEMA AB 1 and UL 489. Units operating at 400 Hz shall be derated for 400 Hz operation.

2.2.4.2 Input Circuit Breaker

Provide converter with an UL listed input circuit breaker of appropriate rating as an integral part of the converter. Breaker shall be operable from the front of the converter.

Output Contactor

Provide converter output with an automatic magnetically-held contactor with interlock circuit. Output contactor shall be of sufficient capacity to handle rated load, overload, and available short circuit current. Contactor shall be tripped by any circuit identified in the paragraph entitled "Protective Control." Output contactor shall be electrically interlocked with ON/OFF circuitry so that when the frequency converter is shut down, the contactor shall open immediately and remain open. Conform to the requirements of IEC 158-1.

2.2.4.3 Aircraft Interlock Circuit

Interlock circuit shall determine the presence or absence of the 28 VDC feedback signal from the aircraft. Interlock circuit shall not allow the output disconnect to close if the 28 VDC signal is not present. If the output disconnect is closed when the 28 VDC is lost, the disconnect shall open within 2 seconds. Converter shall contain terminal block points for the connection of two 12 AWG wire from the aircraft cable assembly for the interlock circuit. Interlock circuit shall not draw more than 20 milliamperes from the aircraft's 28 VDC circuit. For testing purposes, provide a switch inside the converter with two positions:

a. Normal - For aircraft loads.

2.2.5 Protective Controls

Provide circuitry for the following protective controls.

a. Input undervoltage.

b. Input overvoltage.

c. Loss of phase.

d. Loss of input power.

e. Door interlock - When any access door is opened, the interlock circuitry shall open the 60 Hz input device and 400 Hz output device and not allow the input or output device to close. For maintenance purposes, provide a bypass switch to defeat the interlock circuitry.

f. Output overvoltage - Protect by tripping output devices for instantaneous overvoltage of 30 percent or more and for 10 to 30 percent overvoltage lasting more than 0.25 second.

g. Output undervoltage - Protect by preventing the closing of the output disconnect until the output voltage is 95 percent of the rated output. If, after closing, the voltage decreases to below 90 percent for longer than 5 seconds, provide relaying to trip output devices utilizing a field-adjustable time-delayed circuit with a range of 4 to 10 seconds.

h. Output frequency - Protect by tripping output devices for frequency change in excess of plus or minus 5 percent of the rated output frequency (400 HZ).

i. Output overload.

2.2.6 NOT USED

2.2.7 Automatic Line Drop Compensation

Provide automatic line drop compensation - 0 to 7 percent selectable internally.

2.2.8 NOT USED

2.2.9 NOT USED

2.2.10 Built-In Test Equipment

Frequency converter shall include built-in test equipment which monitors both primary circuits and protection circuits of the unit. Provide visual indication to assist diagnosis of unit failures to a modular level.

2.2.11 Magnetic Devices

Provide Class 180 power magnetic transformer and inductors in accordance with NEMA ST 20 and UL 506. The limits of Class 180 shall not be exceeded at the maximum specified ambient temperature and at 100 percent load.

2.2.12 Assembly Construction

Provide enclosures suitable for indoor environments in accordance with NEMA 250, Type l. Arrange to provide required louvers, cooling air, entry and exit provisions for equipment within enclosures. Construct unit(s) so that components, with the exception of control and monitoring components, are totally enclosed within the enclosure. Electronic circuits including power circuits shall be modular construction readily accessible for maintenance, repair and module replacement from the exterior of the enclosure. Provide permanent identification tags for wiring. Uniquely identify each wire. Use the same identification system in the wiring diagrams in the Operation and Maintenance Manual. Provide each enclosure with a finish coat over a substrate which has been provided with a rust inhibiting treatment. [Provide two finish coats for outdoor enclosures.] Color shall be the manufacturer's standard color.

2.2.13 Nameplates

As specified in Section 16050, "Basic Electrical Materials and Methods."

2.3 NOT USED

2.4 CONDUIT AND FITTINGS

Specified in Section 16111, "Conduit".

2.5 NOT USED

2.6 SOURCE QUALITY CONTROL

2.6.1 Routine Factory Tests

The manufacturer shall test every converter to ensure compliance with the specification. For tests which require full load, use 0.8 lagging power factor and 1.0 power factor unless otherwise noted. All measurements shall be true RMS measurements. Measurements shall be obtained in accordance

with IEEE 1159. Tests shall include the following:

a. Input current: Operate converter at low and high input voltage at no load and full load. Measure and record current in each phase and neutral if the neutral conductor is connected to the converter input.

b. Input power factor: Operate at low, nominal, and high input voltage at no load, half load, and full load. Measure and record input voltage, input phase currents and input power factor.

c. Output voltage, power, power factor, and voltage regulation: Operate at low, nominal and high input voltage at 25 percent, 50 percent, and 100 percent loads. Loads shall have unity power factor and non-linear load shall be a three phase full wave bridge rectifier with a load required to produce the specified current crest factor. Measure and record output voltage, output current (peak and RMS), output current wave form, power factor and frequency. Verify output voltage and frequency remain within specified regulation limits.

d. Efficiency: Operate at nominal input voltage at half load and full load. Measure and record input voltage, input current, input power factor, output voltage, output current, and output power factor. Calculate the unit efficiency.

e. No load losses: Operate at no load and nominal input voltage. Measure and record input voltage, input current, input power, input power factor, and output voltage.

f. Burn-in: Before delivery, burn-in all units under full load conditions for at least 24 hours by cycling units 6 hours "ON" under full load conditions and 3 hours "OFF" at no load conditions for at least 4 complete "ON" cycles.

2.6.2 Special Factory Tests

The manufacturer shall test one unit of each rating and size converter to assure compliance with the specification. Conduct tests on production model of converters of the same design, construction and kVA rating provided. For all tests which require full load, use 0.8 power factor unless otherwise noted. The tests shall include the following:

a. Surge protection: Apply input surges in accordance with IEEE C62.41, Category B and monitor output. Conduct a minimum of three consecutive successful tests on each unit listed. Confirm there is no interruption to 400 Hz output power and voltage stays within specified regulation tolerances.

b. Inrush current: After applying power to the converter, conduct a minimum of three inrush current tests. Measure and record maximum inrush current after the first half cycle (8 to 10 millisec).

c. Input current distortion: Operate at nominal input voltage at no load, half load, and full load. Measure and record the THD for the current in each phase.

d. Overload/overcurrent: Operate at nominal input voltage with loads listed below:

Percent of Full Load	Minimum Operating Time
110 percent	60 min
125 percent	10 min
150 percent	2 min
200 percent	20 sec
300 percent	6 sec

Monitor output to confirm there is no 400 Hz power interruption.

e. Short-circuit: Apply a bolted line-to-ground, bolted line-to-line, and bolted three phase fault directly to the output terminals of the unit. Conduct a minimum of three consecutive successful tests on each unit. Provide unit capable of carrying the fault current until the integral system protective devices interrupts the fault with no damage to the unit. Provide recordings or display of short circuit current during short circuit tests.

f. Output THD: Operate at nominal input voltage at no load and full load with balanced and 15 percent unbalanced load. A 15 percent unbalanced load is defined as follows:

(1) Phase A at full rated single phase load.

(2) Phase B at 90 percent of Phase A

(3) Phase C at 85 percent of Phase A

Measure and record the THD for the line-to-line voltage, line-to-neutral voltage of each phase current.

g. Amplitude modulation: Operate at no load and full load. Measure and record percentage of amplitude modulation.

h. Phase angle regulation: Operate at no load and full load with balanced and 15 percent unbalanced loads. Measure and record displacement angle between adjacent voltage phases. A 15 percent unbalanced load is defined as follows:

(1) Phase A at full rated single phase load.

(2) Phase B at 85 percent of Phase A.

(3) Phase C at 85 percent of Phase A.

i. Transient recovery: Operate at steady state conditions at 75 percent rated load. Apply a 15 percent load change, as an added load then as a dropped load. Measure and record recovery time and output voltage deviation limits. Provide recordings or display of output voltage during transient recovery test.

j. Acoustical noise: Operate at no load, 50 percent and 100 percent of full load. Measure continuous steady sound pressure level 1525 mm horizontally from the center of each side of the convertor at a point 1525 mm above the floor. Decibels (dB) are referenced to 20 micropascal.

k. Electromagnetic interference (EMI) test: EMI test shall meet the requirements of MIL-STD-461, Part 9, for Class C2 equipment. Certified test results on units of the same design shall be acceptable. Conduct tests in accordance with MIL-STD-462.

l. Paralleling: Operate at nominal input voltage at 50 percent and 100 percent of full load. Measure and record the output voltage, output current and power factor provided by each individual unit.

2.7 28 VDC POWER SUPPLY

Provide 28 vdc converter consisting of modular construction for 480 VAC to 28 VDC conversion, input/output devices, an ancillary control devices. Converter shall be a standard product of the manufacturer and shall be the manufacturers latest design that complies with the specification requirements.

2.7.1 Electrical Characteristics

2.7.1.1 Input Voltage

480Y/277V, three phase, four-wire, grounded, 60 HZ. Converter shall provide rated output voltage when input voltage is varied plus or minus 10 percent. Input power factor between 0.8 and unity at full load.

2.7.1.2 Surge Protection

The converter shall be capable of sustaining an input surge described in and tested in accordance with IEEE C62.41, location Category B, and continue to operate with no alarms within the specified tolerance.

2.7.1.3 Inrush Current

The inrush current shall not exceed 100 percent of the rated full load current.

2.7.1.4 Output Voltage

28 VDC with 1 percent regulation, 1 percent RMS ripple filtered output at full load, 93 percent efficient, 300 percent overload, current limit protection, voltage adjustment from 0 to 100 percent.

2.7.2 Monitoring and Control Panel

Provide converter with integral control panel with the following:

2.7.2.1 Controls

a. Start/Stop pushbutton.

b. Lamp/light emitting diode (LED) test - A push-to-test button or switch to test indicator lamps/LED's.

c. Alarm reset - A pushbutton to silence audible alarms.

d. Emergency power off.

e. Output contactor on/off

f. Current limiting adjust 0-100 percent.

g. Voltage adjust 0-100 percent.

2.7.2.2 Indicators and Meters

a. Input power available - Lamp/LED.

b. Output power on/off - Lamp/LED.

c. System Alarm: Lamp/LED to detect if fault has been detected. Alarm shall remain on until alarm reset has been pressed.

d. Ammeter: 0-500 Amp.

e. Voltmeter: 0-50 Volt.

f. Audible alarm.

2.7.3 Environmental Rating

The converter shall operate satisfactorily from no load to full load under the following conditions:

a. Ambient temperature ranging from 0-55 deg. C.

b. Relative humidity from 0-95 percent non-condensing.

c. Altitude of 6000 ft. without derating.

2.7.4 Construction

Enclosure shall be 14 gage steel, scans continuously welded and ground smooth. ANSI 61 gray polyester powder coating over phosphatized surfaces.

2.7.5 Cooling

Forced air.

2.7.6 Transformer

Class H insulated vacuum impregnated transform designed to 80 deg. C, Class B temperature rise.

PART 3 EXECUTION

3.1 INSTALLATION

Install products to operate at 400 Hz in the same manner as specified in other sections of this specification for products operating at 60 Hz, unless indicated or specified otherwise. Conform to the requirements of NFPA 70 and ANSI C2 and to manufacturer's instructions and recommendations.

3.1.1 Equipment

3.1.1.1 Floor Mounted

Provide proper floor mounting channels and install in the concrete floor

slab in accordance with the manufacturer's drawings and instructions and as indicated. Align, level, and bolt or weld units to channels to allow easy withdrawal or insertion of removable components and to permit proper operation and maintenance of equipment.

3.1.1.2 Wall Mounted

Bracket mount, but otherwise install as required for floor-mounted units.

3.1.2 Grounding

In accordance with NFPA 70 and as specified in Section 16170, "Grounding and Bonding."

3.1.3 Wiring and Conduit

Provide Type XHHW with stranded copper conductors wiring for 400 Hz circuits. Provide wiring for 400 Hz circuits in aluminum or PVC.

3.1.3.1 Conduit

Use aluminum conduit for exposed feeders. Do not install aluminum conduit underground or encased in concrete. Use aluminum fittings and boxes with aluminum conduit. For underground or concrete encasement use PVC.

3.1.4 Manufacturer's Representative

The manufacturer's representative shall place the system in operation and make necessary adjustments to ensure optimum operation of the equipment. The manufacturer's representative shall have at least 2 years of practical experience in the installation and testing of 400 Hz solid state frequency converters.

3.2 FIELD TESTS AND INSPECTIONS

Perform field tests and conduct inspections. Provide labor, equipment tests instruments, and incidentals required for the tests including load banks, except the Government will furnish electricity and test loads. Give the Contracting Officer 7 days notice in writing of the dates and times scheduled for performance tests and submit written copies of test results.

3.2.1 Instruments

The test plan shall list make and model and provide functional description of the test instruments and accessories and shall describe the setup of the tests to be conducted. Provide test instruments capable of measuring and recording or displaying test data at a higher resolution and greater accuracy than specified for the converter's performance. The test instruments used in the field tests shall have current and valid calibration stickers issued by an approved calibration laboratory. Verify calibration and adjustments of converter instruments provided prior to field tests.

3.2.2 Performance Tests

Conduct converter performance tests under the supervision of the manufacturer's representative. Successfully complete the preliminary operation, control and protective devices check prior to performing load

and transient tests. If the converter fails to operate within the specified limits during any of the performance tests the Contractor shall discontinue the test and shall make necessary repairs to correct the failure and retest the converter.

3.2.2.1 Preliminary Operation

Inspect the converter and make adjustments necessary to assure proper operation in accordance with the manufacturer's instructions. Operate frequency converter at 0, 25, 50, 75, and 100 percent of rated full load. Measure and record the output voltage, current and frequency at each load. Verify converter is operating within specified limits at each load level.

3.2.2.2 Control and Protective Device Checks

Operate each control, switch, input/output device that is capable of being operated manually a minimum of three times, demonstrating satisfactory operation each time. Perform operation test on each protective device to ensure that devices functions properly. After each operation measure and record the converter output frequency, voltage and current. Verify converter is operating within specified limits.

3.2.2.3 Load Test

Run each unit continuously a minimum of 2 hours at 100 percent rated load and 6 seconds at 300 percent of rated load. Test shall be at 0.8 leading power factor. After each operation measure and record the converter output frequency, voltage and current. Verify converter is operating within specified limits.

3.2.2.4 Transient Tests

Conduct transient tests on each converter by instantaneously removing 50 percent of rated and then 100 percent of rated load. Provide recordings or displays of voltage and frequency during each transient test, and indicate on the recordings and display the time intervals and acceptable limits for voltage and frequency. Repeat each transient test three times, record the results of each test. Verify converter is operating within specified limits.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

Provide field training to Government personnel on the operation and maintenance of the converter provided. As a minimum the training shall include 2 hours of instruction on the theory of operation and 4 hours on the repair and maintenance of the converters. The instructor shall be approved by the manufacturer of the unit provided. Training shall be approved by the Contracting Officer at least 2 weeks in advance. The Government may record, video and audio, the training sessions and use these recordings to train personnel, on the operation and maintenance of the converter system. Provide two copies of video or audio tapes, if used, in the training sessions to the Contracting Officer.

3.3.2 Harmonic Distortion Tests

Perform harmonic distortion tests as described in IEEE 519 and IEEE 1100. The Contractor shall provide test equipment and instrumentation required

for the tests. Tests shall be conducted with a distortion analyzer with test leads within 3 feet of the frequency converters input terminals. Test data shall include total harmonic distortion amplitudes of all individual harmonics presented in a bar graph format, and fast fourier analysis (FFT) of the harmonics up to the 37th order.

-- End of Section --

SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.4	(1984; R 1990) Mechanical Demand Registers
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C57.12.21	(1980) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVa and Smaller
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM C 478	(1994) Precast Reinforced Concrete Manhole Sections

ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM F 883	(1990) Padlocks

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994) Specifications for Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1987; Rev Mar 1989) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(1995; Supple I; Supple II; Supple III) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.1	(1989; R 1994) Surge Arresters for ac Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1993) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 48	(1996) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1992) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 46 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V

	Through 500 000 V
IEEE Std 592	(1990) Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LA 1	(1992) Surge Arresters
NEMA TC 5	(1990) Corrugated Polyolefin Coilable Plastic Utilities Duct
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 7	(1990) Smooth-Wall Coilable Polyethylene Electrical Plastic Duct
NEMA WC 7	(1993) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1993) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 510	(1994) Insulating Tape
UL 651	(1995) Schedule 40 and 80 Rigid PVC Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions:

a. Altitude 3 m

c. Ambient Temperature 92 degrees F

1.3 SUBMITTALS

Submit under provisions of Section 01300. Refer to Section 16010.

Data

Fault Current and Protective Devices Coordination Studies.

The study shall be submitted with protective device equipment submittals. Not time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog Data.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Procedures.

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

Drawings

Electrical Distribution System.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later

shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

a. Medium-voltage cables and accessories including cable installation plan.

b. Transformers.

c. Surge arresters.

As-Built Drawings.

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

Reports

Factory Test.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing.

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Test Reports.

Six copies of the information described below in 215.9 by 279.4 mm binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Cable Installation Reports.

Six copies of the information described below in 215.9 by 279.4 mm binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

Certificates

Materials and Equipment.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in

accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Splicer Qualification.

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications.

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

OPERATION AND MAINTENANCE MANUALS

Electrical Distribution System.

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of

documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 25 mm in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of liters and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each

transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Conductor Material

Underground cables shall be of soft drawn copper conductor material.

2.4.2 Medium-Voltage Cables

2.4.2.1 General

Medium voltage cables shall conform to the requirements of NEMA WC 7 for cables utilizing ethylene-propylene-rubber (EPR) insulation. Cables shall be in accordance with the requirements of NFPA 70.

2.4.2.2 Insulation

Cables shall utilize ethylene-propylene-rubber (EPR) insulation. Cables

shall be provided with 133 percent insulation level except that 28 kV and 35 kV rated cable insulation thicknesses shall be in accordance with AEIC CS5 or AEIC CS6 as applicable.

2.4.2.3 Jackets

Cables shall be provided with a nonmetallic jacket.

2.4.2.4 Neutrals

Neutral conductors of grounded neutral systems shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable.

2.4.2.5 Shielding

Cables rated for above 2 kV shall have both conductor and insulation shielding for each phase.

2.4.2.6 Ratings

Medium-voltage cables shall be rated for a circuit voltage 15 kV.

2.4.3 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70.

2.4.3.1 NOT USED

2.4.3.2 In Duct

Cables shall be single-conductor cable, Type THWN in accordance with NFPA 70. Cables in factory-installed, coilable-plastic-duct assemblies shall conform to NEMA TC 5 or NEMA TC 7.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type. Joints used in manholes shall be certified by the manufacturer for waterproof, submersible applications.

2.6 CONDUIT AND DUCTS

Ducts shall be as indicated.

2.6.1 NOT USED

2.6.2 Nonmetallic Ducts

2.6.2.1 NOT USED

2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), shall neither slump at a temperature of 150 degrees C (300 degrees F), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes shall be as indicated. Strength of manholes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum.

2.8 NOT USED

2.9 TRANSFORMERS

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.9.1 NOT USED

2.9.2 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the radial type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.9.2.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, oil-immersed, current-limiting, bayonet-type fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or

integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on a second set of high voltage bushings.

2.9.2.2 Load-Break Switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

2.9.2.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the mineral oil-insulated type. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity .....750 kVA.

Impedance 5.75

Temperature Rise .....65 degrees C.

2.9.2.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.9.2.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.10 METERING AND PROTECTIVE DEVICES

2.10.1 NOT USED

2.10.2 Fuses, Medium-Voltage, Including Current-Limiting

2.10.2.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.10.2.2 Ratings

Expulsion-type power fuses shall have ratings in accordance with ANSI C37.46 and as follows:

Nominal circuit voltage.....12470Y/7200.

Rated maximum voltage .....13200Y/7620.

BIL .....95KV.

2.10.3 NOT USED

2.10.4 NOT USED

2.10.4.1 NOT USED

2.10.4.2 NOT USED

2.10.4.3 NOT USED

2.10.4.4 NOT USED

2.10.4.5 Current Transformers for Kwh and Demand Metering (Low-Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through B-0.5, with a minimum RF of 2.0 at 30 degrees C, with 600-volt insulations, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted [on the transformer low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters.

2.10.4.6 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of .3. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.10.5 Watthour Meters

Watthour meters shall comply with ANSI C12.1 and ANSI C12.10, except that numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the drawout switchboard type having a 15 minute, cumulative form, demand register meeting ANSI C12.4 and

provided with not less than 2-1/2 stators. Watthour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures. They shall be capable of operating at speeds up to 500 pulses per minute with no false pulses, and they shall be factory calibrated with no field adjustments being required. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be rated as shown. Arresters for use at elevations in excess of 1.8 km above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

2.12 NOT USED

2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

2.14 PADLOCKS

Padlocks shall conform to ASTM F 883, Type EPC.

2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825 as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 50 mm (2 inches) wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 0.254 mm (10 mil) thick, conforming to UL 510.

2.16 LIQUID DIELECTRICS

Liquid dielectrics for transformers shall be non-polychlorinated biphenyl (PCB) mineral-oil. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used.

2.17 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard routine in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

d. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 20 MPacompressive strength and conform to the requirements of Section 03300CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature,

lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then prepare a checklist of significant requirements, perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 6.4 mm less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 131 cubic centimeters of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 10 degrees C (50 degrees F) temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

Medium-voltage cables, low-voltage cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Cable joints in medium-voltage cables shall be made in manholes. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable.

3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing. Fire-stops shall be installed in each conduit entering or leaving a manhole.

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with

insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the finished grade, the high-point may be at a manhole, or between manholes. The minimum manufactured bend radius shall be 900 mm for ducts 80 mm or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. Separators

or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1.2 m on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 150 mm vertically.

3.5.4 NOT USED

3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.5.1 NOT USED

3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil)brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.6 MANHOLES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 15 mm above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering

cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

3.6.4 NOT USED

3.6.5 NOT USED

3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 100 mm of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 100 mm above finished grade and sloped to drain. Edges of concrete pads shall have 20 mm chamfer. Conduits for primary, secondary, and grounding conductors shall be set in

place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 20 MPa compressive strength and comform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200 CONCRETE REINFORCEMENT.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment. Padlocks shall be keyed as directed by the Contracting Officer.

3.8 NOT USED

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 1.5 m outside of a building and 600 mm below finished grade. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer to the ground ring.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 300 mm below finished grade.

b. Additional electrodes - When the required ground resistance is not

met, additional electrodes shall be provided to achieve the specified ground resistance. The additional electrodes will be up to three, 3 m rods spaced a minimum of 3.7 m apart diameter. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole Grounding

Ground rods installed in manholes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 50 mm above and 150 mm below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole walls and the amount of exposed bare wire shall be held to a minimum.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall

perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of the ground ring shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Ground ring - 10 ohms.

3.11.4 NOT USED

3.11.5 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test

voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.11.7 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.11.8 NOT USED

3.11.9 NOT USED

3.11.10 NOT USED

3.11.11 NOT USED

3.11.12 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Pad-mounted transformers

b. Switches

3.11.13 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SAFETY PAYS

Modular Design System

SECTION 16441

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fusible Disconnect switches.

B. Nonfusible Disconnect switches.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical

B. Section 16170 - Grounding and Bonding

C. Section 16180 - Equipment Wiring Systems

D. Section 16190 - Supporting Devices

E. Section 16195 - Electrical Identification

F. Section 16477 - Fuses

1.3 CODES AND STANDARDS

A. NEMA ICS6 - Enclosure for Industrial Controls Systems

B. NEMA KS 1 - Enclosed Switches.

C. NFPA 70 - National Electrical Code.

D. NECA - Standard for Installation.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different disconnect switch. The information shall

be in the form of the manufacturer's standard data sheets.

1. Voltage rating
2. Ampere rating
3. Horsepower rating
4. Number of poles
5. Switch and contact materials
6. Fuseclips
7. Fuse type and ratings
8. Handle; interlock and padlocking provisions.
9. Enclosure type
10. Enclosure material and finish.
11. Dimensioned picture or drawing of the switch.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of the switch.

1.5 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance Data: Submittal data sheets.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standards listed in Section 16010.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated. Products shall bear the UL

Label.

1.9 FIELD MEASUREMENTS

A. The locations of disconnect switches indicated on the drawings are approximate. Coordinate the exact location with equipment, etc. so that access and proper clearances are maintained.

1.10 EXTRA MATERIALS

A. Provide three of each size and type of fuses installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. General Electric

B. Siemens ITE

C. Square D

D. Westinghouse

E. Approved equal

2.2 ENCLOSED SWITCHES

A. Fusible Switch Assemblies: 600 volt, Type HD, horsepower rated, load interrupter enclosed knife switch with high conductivity copper current carring parts, silver-tungsten type contact surfaces and externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position with two padlock provisions. Fuse clips: Positive pressure reinforced designed to accommodate Class R fuses.

B. Nonfusible Switch Assemblies: 600 volt, Type HD, horsepower rated, load interrupter enclosed knife switch with high conductivity copper current carring parts, silver-tungsten type contact surfaces and externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position with two padlock provisions.

C. Ratings: The number of poles, switch ampere rating and fuse ampere rating shall be as indicated.

D. Fuses: UL Class RK1 unless otherwise indicated. Refer to Section 16477 - Fuses.

E. Enclosures: Surface mounted, code gauge steel with manufacturer's standard gray enamel finish.

1. Interior Dry Locations: NEMA Type 1.
2. Exterior Locations: NEMA Type 3R.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install disconnect switches level and plumb.

B. Install fuses in fusible disconnect switches.

C. Provide proper anchors and supports. Refer to Section 16190.

D. Identify each disconnect switch, by attaching to the device cover a laminated plastic nameplate clearly and permanently lettered with the description and location of the equipment controlled by the device and the circuit number and origin from which it is fed. The nameplate shall be black with 6 mm minimum high white characters.

END OF SECTION

SECTION 16461

DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dry type two winding transformers.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical.

B. Section 16170 - Grounding and Bonding.

C. Section 16190 - Supporting Devices.

D. Section 16191 - Seismic Restraint Systems.

1.3 REFERENCES

A. NEMA ST 20 - Dry Type Transformers for General Applications.

B. NFPA 70 - National Electrical Code.

C. UL 1561 - Dry-Type General Purpose and Power Transformers.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each transformer. The information shall be in the form of the manufacturer's standard data sheets or drawings.

1. KVA rating
2. Voltage ratings
3. Winding configuration and taps
4. Temperature rise rating
5. Insulation type and rating
6. Impedance

7. Noise level
8. Weight
9. Cabinet material
10. Finish
11. Dimensioned picture or drawing

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation, of the transformer.

1.5 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance data: Submittal data sheets.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standards listed in Section 16010.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated. Products shall bear the UL Label.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store, protect, and handle products to site under provisions of Section 16010.

B. Deliver transformers individually wrapped for protection and mounted on shipping skids.

C. Accept transformers on site. Inspect for damage.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. General Electric
2. Siemens ITE
3. Square D
4. Cutler-Hammer/Westinghouse
5. Approved equal

B. Description: factory-assembled, air cooled dry type transformers, two-winding type, 600 volt or less, single or 3-phase, as indicated with one coil per phase in primary and secondary; ratings as indicated. 3-phase transformers shall be connected delta on the primary and wye connected on the secondary.

C. Cores: Grain-oriented, nonaging silicon steel.

D. Insulation system and average winding temperature rise for rated KVA as follows:

1. 15 KVA or Less: Class 185 or 220 with 115 degrees C

rise.

2. Larger than 15 KVA: Class 220 with 115 degrees C rise.

E. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point.

F. Winding Taps:

1. Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 KVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below rated voltage.

G. Sound Levels:

0 - 9 KVA:	40 dB
10-50 KVA:	45 dB
51-150 KVA:	50 dB
151-300 KVA:	55 dB
301-500 KVA:	60 dB

H. Basic Impulse Level: 10 KV for transformers less than 300 KVA, 30 KV for transformers 300 KVA and larger.

I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

J. Mounting: 15 KVA and smaller - floor or wall mounted; above 15 KVA - floor mounted.

K. Coil Conductors: Copper continuous windings without splices except for taps with terminations brazed, welded or pressure type.

L. Where transformers are indicated as shielded isolation type, they shall have an electrostatic shield and a K-factor of 13.

M. Enclosure: Code gauge steel; NEMA Type 1, ventilated or totally enclosed nonventilated as indicated. Provide lifting eyes or brackets. Finish shall be manufacturer's standard gray enamel.

N. Isolate core and coil from enclosure using neoprene vibration-absorbing mounts.

O. Fungus Proofing: Permanent fungicidal treatment for coil and core.

2.2 SOURCE QUALITY CONTROL

A. Provide production testing of each unit in accordance with NEMA ST20.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are suitable for installing transformer supports.

3.2 PREPARATION

A. Provide concrete pad under provisions of Section 16010.

3.3 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Set transformer plumb and level.

C. Use flexible conduit, under the provisions of Section 16111, 0.6 m minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

D. Mount transformers on neoprene vibration isolating pads suitable for isolating the transformer noise from the building structure.

E. Provide seismic restraints as per Section 16191.

F. Provide grounding and bonding in accordance with Section

16170 and as indicated.

G. Identification: Identify each transformer with a laminated plastic nameplate engraved with 13 mm minimum height characters showing the designation indicated on the drawings, the circuit number and device size from which it is fed and the primary feeder size. The nameplate shall be black with white characters and secured to the front of the transformer.

3.4 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Service and distribution panelboards.

B. Lighting and Appliance Branch circuit panelboards (hereafter referred to as branch circuit panelboards).

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical.

B. Section 16190 - Supporting Devices.

C. Section 16195 - Electrical Identification.

D. Section 16477 - Fuses.

1.3 CODES AND STANDARDS

A. NECA (National Electrical Contractors Association) "Standard of Installation".

B. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

C. NEMA FU 1 - Low Voltage Cartridge Fuses

D. NEMA KS 1 - Enclosed Switches.

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

G. NEMA PB2.2 - Application Guide for Ground Fault Protective Devices for Equipment.

H. NFPA 70 - National Electrical Code.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

J. UL 50 - Cabinets and Boxes

K. UL 67 - Panelboards

L. UL 98 - Enclosed and Dead-Front Switches

M. UL 198C - High-Interrupting-Capacity Fuses, Current-Limiting Types

N. UL 198D - High-Interrupting-Capacity Fuses, Class K fuses.

O. UL 198E - Class R Fuses

P. UL 198G - Fuses for Supplementary Overcurrent Protection

Q. UL 486A-80-Wire Connectors And Soldering Lugs For Use With Copper Conductors.

R. UL 489 - Molded-Case Circuit Breakers and Circuit - Breaker Enclosures.

S. UL 512 - Fuseholders

T. UL 869A - Service Equipment

U. UL 1053-88 - Ground-Fault Sensing and Relaying Equipment.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each panelboard. The information may be in the form of schedules, and/or manufactures standard drawings. The manufacturers standard drawings shall indicate, by panel designation, the panelboard for which they apply.
   1. Panelboard designation from the construction drawings.
   2. Manufacturer's series or catalog number.

3. Enclosure NEMA rating (1, 3R, etc.)
4. Metal gage for backbox, dead-front and trim.
5. Enclosure mounting type (flush, surface, etc.)
6. Backbox and panel interior mounting provisions.
7. Front and/or rear accessibility.
8. Enclosure dimensions (height, width, depth)
9. Trim type (flush, with door; surface, without door; etc.) and the method for securing trim to the panel.
10. Type of door latch, lock and hinges.
11. Finish of the panel, deadfront and trim.
12. Top or bottom feed.
13. Gutter sizes.
14. Removable end panels (blank or with knockouts)
15. Voltage rating
16. Number of phases and phasing diagram.
17. Neutral bus (if required)
18. Equipment ground bus
19. Isolated ground bus (if required)
20. Frequency
21. Material and ampere rating of main lugs, and phase, neutral and ground busses.
22. Bus insulation and isolation material.
23. Designation, quantity, voltage, load and fault current ampere ratings for overcurrent devices including spares.
24. Termination temperature ratings of lugs and overcurrent devices.
25. Settings for adjustable circuit breakers.
26. Fuse sizes and designations (U.L. class)
27. Number of provisions including circuit breaker frame sizes, fused switch sizes and poles.

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and start-up of the panelboards.

1.5 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include spare parts data listing; source of replacement parts and supplies; and recommended maintenance procedures and intervals.

B. Refer to Section 16010.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in Section 16010.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated. Products shall bear the UL label.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated.

1.10 MAINTENANCE MATERIALS

A. Provide 6 panelboard keys.

B. Provide two fuse pullers.

C. Obtain a signed receipt from the user's representative for all materials provided.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. G.E.

B. Square D

C. Cutler-Hammer/Westinghouse

D. Siemens

E. Approved equal

2.2 MAIN DISTRIBUTION AND BRANCH CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, dead-front circuit breaker type, or fused switch type as indicated for 600 volts or less, 100 - 1200 amps and group mounted devices. Load centers are not acceptable.

B. Service Conditions:

1. Temperature: 92 degrees F.
2. Altitude: 3 meters above sea level.

C. Panelboard Buses: Provide tin plated copper phase buses, connector fingers and neutral buses of 98 percent conductivity, and ratings as indicated. Provide a separate copper equipment ground bus, bonded to the cabinet, in each panelboard. Provide a separate copper isolated ground bus, insulated from the cabinet where indicated. Phase buses shall be one continuous bar per phase, factory assembled and provide sequentially phased

branch distribution. Phase buses shall be separated and rigidly supported by insulating material rated for the applicable voltage, amperage and fault currents. The neutral bus shall have the same ampere rating as the phase buses or 200 percent of the phase buses where indicated. Provide a neutral bonding strap for panels rated for service equipment. Neutral and ground buses shall have a separate lug for each wire connection. All buses shall be labeled or identified as to their purpose.

D. Cable Connections: Cable connection lugs shall be copper alloy, compression solderless lugs rated for the type and temperature rating of the wire used.

E. Main Devices: These shall be main lugs, fused switch or circuit breaker as indicated.

F. Minimum integrated short circuit rating: As indicated.

G. Device Mounting: Circuit breakers and fused switches shall be capable of being removed or installed without disturbing adjacent devices.

H. Provisions for Future Devices: Provisions for future fused switches and circuit breakers shall be equipped with hardware and busses to accept the size switch or breaker indicated.

I. Enclosure: NEMA PB 1, Type 1,3R or 12; flush or surface mounted as indicated.

J. NEMA 1 Enclosure: Backbox shall be galvanized, code thickness, steel with removable end walls, adjustable panel interior mounting studs or brackets and provisions for mounting the panel deadfront and trim. End walls may or may not have knockouts for conduits. Backboxes shall be sized to provide wiring gutter space per the N.E.C. and U.L. standards. The backbox shall have a separate UL label from the panelboard. The backbox shall be provided by the same manufacturer as the panelboard.

Branch circuit and distribution panelboards shall have dead-front trims of code thickness, secured to the panel interior with screws. The dead-front for circuit breaker

panels shall have twist out, or snap-in fillers or plates secured with screws for device provisions. The dead-front for fused switch panels shall have metal plates secured with screws for provisions. All flush mounted branch circuit and distribution panelboards shall have one piece flush trims which overlap the backbox a minimum 19 mm on all sides with hinged doors and trim clamps for adjusting. Surface mounted branch circuit panelboards shall have one piece surface trims, which is the same size as the backbox with hinged doors and trim clamps for adjusting. Surface mounted distribution panels shall have one or four piece surface trims which is the same size as the backbox without hinged doors and secured with screws.

Doors in flush or surface mounted branch circuit panel trims and flush mounted distribution panel trims shall have concealed hinges, and flush mounted latch and cylinder lock. Doors in surface mounted distribution panel trims shall have flush mounted latch or handle and flush mounted cylinder lock and may have exposed hinges. Doors over 1220 mm high shall have three point latching. All locks shall be keyed alike. Doors shall have a metal directory card frame with a circuit directory card and clear plastic cover mounted on the inside face.

Dead-fronts and flush and surface trims shall be phosphatized steel and finished in the manufacturer's standard baked or electrodeposited gray enamel or lacquer finish unless otherwise indicated.

K. NEMA 3R and 12 Enclosure: Enclosure shall be phosphatized steel, of code thickness, with a dead-front panel, gasketed door with a vault lock handle and a minimum of two trunk latches. There shall be no conduit knock-outs in any walls of the enclosure. The enclosure shall have adjustable panel interior mounting studs or brackets and provisions for mounting the panel deadfront. The enclosure shall be sized to provide wiring gutter space per the N.E.C. and UL standards. The enclosure shall have a separate UL label from the panelboard. The enclosure shall be provided by the same manufacturer as the panelboard. The door shall have a metal directory card frame with a circuit directory card and a clear plastic cover mounted on the inside face. The dead-front and door

shall be phosphatized steel, of code thickness. The dead-front panel shall have twist out, snap-in fillers or plates secured with screws for device provisions. All exposed hardware such as handles, hinges, latches, etc. shall be stainless steel. All locks shall be keyed alike. The enclosure body, dead-front and door shall be manufacturer's standard baked-on or electrodeposited gray enamel or lacquer finish unless otherwise indicated.

L. Panelboards Used as Service Equipment: Where panelboards are used as service equipment, they shall be U.L. Listed as "Suitable for Use as Service Equipment" and bear the U.L. label.

M. All panelboards shall be of the same manufacturer.

2.3 CIRCUIT BREAKERS

A. Circuit breakers shall be as specified and of the types as listed below.

B. Circuit breakers shall have voltage, current, pole and interrupting ratings as indicated. Series rated circuit breakers in combinations approved for series applications by UL shall be provided as indicated, for specific pieces of distribution equipment, to obtain the specified interrupting rating. Fully rated circuit breakers will be acceptable where the series rated is specified. Panelboards containing series rated circuit breakers shall be appropriately marked for use with the specified breakers at the designated short circuit level.

C. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type, automatic, integral thermal and instantaneous magnetic trip in each pole, with common trip handle for all poles. Single pole breakers with field installed handle ties are not acceptable. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupted circuit breakers where schedule. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Do not use tandem circuit breakers.

D. Current Limiting Molded Case Circuit Breakers: NEMA AB 1,

bolt-on type circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

E. Provide circuit breaker accessory trip units and auxiliary switches as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with manufacturer's requirements.

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 16190.

C. Panelboards shall not be supported by branch circuit or feeder conduits.

D. Provide one required size bolt in each mounting hole in the backbox.

E. Mounting Height: 2 m - 150 mm above the finished floor to top of panelboard; install panelboards taller than 2 m - 150 mm such that the operating handle of the top devices is no more than 2 m - 150 mm above the finished floor.

F. Provide filler plugs for unused conduit openings in panelboards.

G. Provide spare conduits out of each recessed branch circuit and distribution panelboard up to the nearest accessible ceiling space. Provide one 16 mm conduit for every three spare single pole breakers or provisions. Provide one conduit for each two and three pole spare breaker or switch or provision. The conduit size shall be based on a four wire circuit for two pole breakers and switches and on a five wire circuit for three pole breakers and

switches and on the corresponding phase, neutral and equipment grounding conductor for the spare or provision breaker frame or switch size. Spare conduits shall be capped. Spare conduits may not be provided for surface mounted panelboards unless otherwise indicated.

H. Train conductors, in panel gutters, neatly in groups, bundle, and wrap with wire ties.

I. Do not install panelboards under piping or ductwork.

J. Identification

1. Identification of Circuits and Equipment: Identification designations shall correspond to those indicated on the electrical drawings.
2. Each overcurrent device in panelboards with doors shall be permanently identified by circuit number on the dead-front with additional information on the directory card.

   Each overcurrent device in panelboards without doors shall be permanently identified by a laminated plastic nameplate engraved with 3 mm minimum height characters showing the circuit number, the load served by the device and the location of the load. The nameplate shall be white with black characters and securely attached to the dead-front or the hinged door for fused switches.
3. Clearly typewrite on each panelboard directory card the designations of the fixtures, outlets and equipment served by each device in the panelboard reflecting as-built circuiting. Panelboard directory cards shall indicate actual assigned room numbers and not those indicated on the plans if different.
4. Identify each entire panelboard assembly with a laminated plastic nameplate engraved with 16 mm minimum height characters showing panelboard designation. The nameplate shall be white with black characters and securely attached to the outside front of the panel. Provide an additional separate laminated plastic sign of the same specifications which indicates the feeder size, circuit number, protective device size and origin from which it is

fed and securely attach to the inside of panelboard door over directory card for panels with doors and on the outside of the trim for panels without doors.

5. Each panelboard shall have a metal nameplate with the panel voltage, phases, wire, ampere and frequency ratings stamped or engraved on the plate. The manufacturer's name, model number, etc. and the UL label shall also be permanently printed on the plate. The plate shall be attached to the deadfront of the panelboard.

3.2 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01440.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for lugs, circuit breakers, fusible switches and fuses. Exercise all devices for proper operaiton. Touch-up all scratches in the finish with manufacturer's approved touch-up paint. Check all labeling for compliance with the specifications. Check for piping or ductwork that may have been installed over the panelboard after installation.

END OF SECTION

SECTION 16477

FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical

B. Section 16180 - Equipment Wiring Systems

C. Section 16441 - Enclosed Switches

D. Section 16470 - Panelboards

E. Section 16481 - Enclosed Motor Controllers

1.3 CODES AND STANDARDS

A. NFPA 70 - National Electric Code.

B. NEMA FU 1 - Low Voltage Cartridge Fuses.

C. UL 198C - High-Interrupting Capacity Fuser; Current Limiting Type.

D. UL 198E - Class R Fuses

1.4 SUBMITTALS: Submit under provisions of Section 01300.

A. Product Data: Provide data sheets showing electrical characteristics including time-current curves for each different type and size fuse.

1.5 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance Data: Submittal data sheets.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with codes and standards listed in Section 16010.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated. Products shall bear the UL Label.

1.9 MAINTENANCE MATERIALS

A. Provide two fuse pullers.

1.10 EXTRA MATERIALS

A. Provide three of each size and type fuse installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bussman

Modular Design System

B. Brush Fuse

C. Gould Shawmut

D. Approved equal

2.2 FUSE REQUIREMENTS

A. Description: Nonrenewable, dual element, cartridge type; UL, Class as specified or indicated.

B. Amperage: As indicated.

C. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage indicated.

D. Fuses up to 600 amperes: UL Class RK1 time delay, current limiting type, 200,000 A.I.C. unless otherwise indicated.

E. Fuses over 600 amperes: UL Class L, time delay, current limiting type, 200,000 A.I.C. unless otherwise indicated.

F. All fuses shall be of the same manufacturer.

2.3 SPARE FUSE CABINET

A. Description: Wall-mounted code gauge steel cabinet, suitably sized to store spare fuses and fuse pullers specified.

B. Doors: Hinged, with hasp for User's padlock.

C. Finish: Manufacturer's standard gray enamel finish.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fuses in accordance with manufacturer's instructions.

B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet where indicated.

END OF SECTION

SECTION 16481

ENCLOSED MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manual motor starters.

B. Magnetic motor starters.

C. Combination magnetic motor starters.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical

B. Section 16170 - Grounding and Bonding

C. Section 16180 - Equipment Wiring Systems

D. Section 16190 - Supporting Devices

E. Section 16195 - Electrical Identification

F. Section 16477 - Fuses

1.3 CODES AND STANDARDS

A. NFPA 70 - National Electrical Code.

B. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.

C. UL 508 - Industrial Control Equipment

D. UL 198E - Class R Fuses.

E. UL 468A - Wire Connectors and Soldering Lugs for Use With Copper Conductors.

F. NECA "Standard of Installation," published by National Electrical Contractors Association.

G. NEMA AB 1 - Molded Case Circuit Breakers.

H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

I. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

J. NEMA KS 1 - Enclosed Switches.

K. NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different motor controller. The information shall be in the form of the manufacturer's standard data sheets.

1. Manufacturer's series or catalog number.
2. Enclosure NEMA type, material, interlocks, finish, etc.
3. Motor starter type
4. Starter NEMA size
5. Voltage rating
6. Contact material
7. Coil voltage
8. Overload relay type and number
9. Number, type and ratings of auxiliary contacts
10. Types and ratings of pushbuttons, indicating lights and selector switches
11. Types and ratings of auxiliary relays
12. Disconnect type
13. Frame or switch size
14. Voltage and amperage ratings
15. Fault current interrupting rating
16. Fuse class, type and ratings

B. Manufacturer's Installation Instructions: Indicate

application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of the motor controller.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standards listed in Section 16010.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated. Products shall bear the UL Label.

1.8 FIELD MEASUREMENTS

A. The locations of enclosed motor controllers indicated on the drawings are approximate. Coordinate the exact location with equipment, etc., so that access and proper clearances are maintained.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. General Electric

B. Siemens ITE

C. Square D

Modular Design System

D. Cutler-Hammer/Westinghouse

E. Approved equal

2.2 MANUAL CONTROLLERS

A. Manual Motor Controller: Single, double or three pole as indicated, AC general-purpose Class A manually operated, full-voltage controller with manual reset overload element, in each phase, red pilot light, auxiliary contact as indicated, and push button or toggle operator.

B. Fractional Horsepower Manual Controller: single or double pole as indicated, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with manual reset thermal overload unit in each phase, red pilot light, and toggle operator.

C. Motor Starting Switch: Single pole, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, with red pilot light and toggle operator.

D. Enclosure: NEMA; Type as indicated; flush or surface mounted as indicated.

2.3 AUTOMATIC CONTROLLERS

A. Magnetic Motor Controllers: Across-the-line type, full voltage, non-reversing unless otherwise indicated, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Contacts shall be copper with weld resistant silver cadmium oxide.

B. Two Speed Controllers: Include integral time delay transition between FAST and SLOW speeds and pushbuttons and pilot lights for each speed.

2.4 PRODUCT OPTIONS AND FEATURES

A. Coil operating voltage: Phase voltage if all controls are

within the controller enclosure; 120 volts if control circuits extend outside of the controller enclosure.

B. Overload Relay: Class 10; bimetal; manual reset; one overload in each phase; integral with controller.

C. Auxiliary Contacts: 2 each normally open and closed contacts in addition to seal-in contact.

D. Cover Mounted Pilot Devices: heavy duty oiltight type.

E. Pilot Device Contacts: Form Z, rated A150.

F. Pushbuttons: Shrouded momentary contact type.

G. Indicating Lights: neon type.

H. Selector Switches: Rotary type, 3 position, manual-off-automatic.

I. Relays: Solid state phase loss relay to monitor voltage of all 3 phases.

J. Control Power Transformers: 120 volt secondary, 50 va minimum, in each motor starter. Provide fused secondary, and bond unfused leg of secondary to enclosure.

K. Control Voltage: Line voltage where all controls are within the controller enclosure; 120 volts ac where control devices are located outside of the controller enclosure.

L. Enclosure: Code gauge steel; NEMA Type As indicated with locking provisions and manufacturer's standard gray enamel finish.

2.5 DISCONNECTS

A. Combination Controllers: Combine motor controllers with non-fusible switch or fusible switch disconnect as indicated in common enclosure. The cover of the enclosure shall be interlocked with the operating handle of the switch so that

the cover cannot be opened unless the switch handle is in the off position.

B. Nonfusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle and locking provisions.

B. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle and locking provisions. Fuse clips: Designed to accommodate Class R fuses.

2.6 FUSES

A. Refer to Section 16477.

B. Description: Dual element, current limiting, time delay, one-time fuse, 250 or 600 volt as indicated, UL Class RK 1 unless otherwise indicated.

C. Interrupting Rating: 200,000 rms amperes.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.

B. Install enclosed controllers plumb. Provide supports in accordance with Section 16190.

C. Height: 1.6 m to operating handle.

D. Install fuses in fusible switches.

E. Select and install overload heater elements in motor controllers to match installed motor characteristics.

F. Install wiring in enclosures neatly trained.

G. Provide engraved plastic nameplates under the provisions of

Section 16195. Identify each magnetic motor starter, and manual motor starter, by attaching to the device cover a laminated plastic nameplate clearly and permanently lettered with the description and location of the equipment controlled by the device and the circuit number and origin from which it is fed. The nameplate shall be black with 6 mm high white characters.

3.2 FIELD QUALITY CONTROL

A. Verify correct phasing and rotation of motors.

B. Measure the voltage and amperage for each phase and verify that measurements are within motor nameplate ratings.

END OF SECTION

SECTION 16485

CONTACTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power contactors.

B. Lighting contactors.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical

B. Section 16170 - Grounding and Bonding

C. Section 16180 - Equipment Wiring Systems

D. Section 16190 - Supporting Devices

E. Section 16195 - Electrical Identification

F. Section 16530 - Exterior Lighting

1.3 CODES AND STANDARDS

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different contactor. The information shall be in the

form of manufacturer's standard data sheets or drawings. The data sheets or drawings shall indicate, by contactor designation, the contactor for which they apply.

1. Manufacturer's series or catalog number
2. Enclosure NEMA rating and dimensions
3. Enclosure material and finish
4. Contactor type
5. Number of poles
6. Voltage and amperage ratings of contacts
7. Contact material
8. Coil voltage
9. Control relay
10. Type and ratings of selector switch
11. Wiring diagram

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of the contactor.

1.5 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance Data: Submittal data sheets; include instructions for replacing and maintaining coil and contacts.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in Section 16010.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

Modular Design System

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated. Products shall bear the UL Label.

1.9 FIELD MEASUREMENTS

A. The locations of contactors indicated on the drawings are approximate. Coordinate the exact location with equipment, etc. so that access and proper clearances are maintained.

PART 2 PRODUCTS

2.1 LIGHTING CONTACTORS

A. Mechanically or Magnetically Held Lighting Contactors:

1. Manufacturers:
   (1) Asco 917
   (2) G.E. CR160MA
   (3) Square D Class 8903 type LX
   (4) Cutler-Hammer/Westinghouse Class A202
   (5) Approved equal

2. Description:
   a. Number of poles as required for switching configuration as shown.
   b. Load contacts rated 20 amperes continuous, at 120/208 or 480/277 volts for tungsten, fluorescent or H.I.D. lighting loads.
   c. Coil voltage 120 VAC or 24 VDC, coordinate with controls contractor.
   d. Control relay or module for two wire control.
   e. Coil clearing contacts so that contactor coils shall be energized only during the instance of operation.
   f. NEMA Type 1 enclosure; code gauge steel with manufacturer's standard gray enamel finish.
   g. Hand/off/Auto Selector Switch

2.2 POWER CONTACTORS

A. Mechanically or Magnetically Held Power Contactors:

1. Manufacturers:
   (1) G.E. CR360MA
   (2) Square D Class 8903
   (3) Approved equal

2. Description:
   a. Number of poles as indicated
   b. Load contacts rated for the continuous amperage and voltage as indicated

c. Control voltage 120 VAC
d. Control relay or module for two wire control.
e. Coil clearing contacts so that contactors coils shall be energized only during the instance of operation.
f. NEMA Type 1 enclosure; code gauge steel with manufacturer's standard gray enamel finish.
g. Hand/off/Auto Selector Switch

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide a laminated plastic nameplate attached with screws or rivets to the outside of the enclosure. The nameplate shall be black with 6 mm high white characters which indicates the contactor designation, the item and the circuits it controls.

END OF SECTION

SECTION 16510

LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior lighting fixtures and accessories.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts.

E. Fluorescent lamp emergency power supply.

F. Lamps.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - Electrical.

B. Section 16170 - Grounding and Bonding.

C. Section 16190 - Supporting Device.

1.3 CODES AND STANDARDS

A. ANSI C78.1 to C78.1502 Standards for Various Types of Lamps.

B. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.

C. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.

D. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).

E. NFPA 70 - National Electrical Code.

F. NFPA 101 - Life Safety Code.

G. UL 924 - Emergency Lighting and Power Equipment.

H. UL 935 - Fluorescent Lamp Ballasts.

I. UL 1029 - High-Intensity Discharge Lamp Ballasts.

J. UL 1570 - Fluorescent Lighting Fixtures.

K. UL 1571 - Incandescent Lighting Fixtures.

L. UL 1572 - High-Intensity Discharge Lighting Fixtures.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Data Sheets: Submit as a minimum the following information on each different fixture, ballast, lamp, exit sign, and emergency power unit. The information shall be in the form of the manufacturer's standard data sheets. Each lighting fixture data sheet shall indicate, by fixture type, the lighting fixture for which it applies.

1. Lighting Fixtures
    a. Manufacturer's series or catalog number
    b. Dimensioned picture or drawings
    c. Material of housings, brackets, etc.
    d. Finish
    e. Ballast type
    f. Lamp type
    g. Voltage
    h. Lens material, thickness and pattern
    i. Louver or reflector material, depth, number of cells, and finish
    j. Mounting hardware
    k. Photometrics and coefficient of utilization tables.
    l. Pt by Pt calculations and maximum to minimum ratios for all exterior pole mounted, wall mounted, and

bollard fixtures. Calculations must be shown on appropriated scaled drawings.

2. Ballasts
   a. Manufacturer's series or catalog number
   b. Ballast type
   c. Voltage
   d. Wattage
   e. Power factor
   f. Crest factor
   g. Harmonic factor

3. Emergency Lighting Units
   a. Manufacturer's series or catalog number
   b. Dimensioned picture or drawing
   c. Housing material and finish
   d. Battery type and rated life
   e. AC and DC voltages
   f. Charger type and charging modes
   g. Fixture and lamp type
   h. Test switch and indicator lights
   i. Control circuitry
   j. Photometric for lamps

4. Exit Signs
   a. Manufacturer's series or catalog number
   b. Dimensioned picture or drawing
   c. Housing material and finish
   d. Lens material and character size
   e. Down light
   f. Battery type and rated life
   g. AC and DC voltage
   h. Charger type and charging modes
   i. Lamp type
   j. Test switch and indicator lights
   k. Control circuitry

5. Fluorescent Lamp Emergency Power Supply
   a. Manufacturer's series or catalog number
   b. Dimensioned picture or drawing
   c. Battery type and rated life

d. AC and DC voltages
e. Charger type and charging modes
f. Test switch and indicator lights
g. Control circuitry

6. Lamps
a. Manufacturer's series or catalog number
b. Picture or drawings
c. Lamp designation
d. Base or pin type
e. Voltage
f. Starting mode
g. Burning temperature
h. Color rendering index
i. Diffuser coatings and reflectors

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in Section 16010.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and

indicated. Products shall bear the U.L. Label.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURES

A. Provide fixtures as specified on the Drawings.

B. Install ballasts, lamps, and specified accessories at factory.

2.2 EMERGENCY LIGHTING UNITS AND EXIT SIGNS

A. Provide emergency lighting units and exit signs as specified on the drawings.

2.3 BALLASTS

A. Fluorescent Ballast:

1. Manufacturers:
   a. Advance - Mark V Series
   b. Magnetek - Triad Series
   c. Universal - Genesis Series
   d. Valmont - Ultra-miser Series
   e. Approved equal.

2. Description:
   a. Class P, high power factor type electronic ballast.
   b. Provide ballast suitable for lamps specified.
   c. Voltage: As indicated.
   d. Source Quality Control: Certify ballast design and construction by Certified Ballast Manufacturers, Inc.

B. Compact Fluorescent Ballast:

1. Manufacturers:
   a. Advance
   b. Universal

c. Valmont
d. Approved equal

2. Description:
a. High power factor type.

C. High Intensity Discharge (HID) Ballast:

1. Manufacturers:
a. Advance
b. Universal
c. Valmont
d. Approved equal

2. Description
a. High-Intensity-Discharge (HID) Ballasts shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Ballasts shall be designed to operate on the voltage system and lamp to which they are connected. Provide single lamp ballasts with a minimum starting temperature of minus 30 degrees Celsius (C). Ballasts shall be constructed so that open circuit operation will not reduce their average life. High Pressure Sodium (HPS) ballasts shall have a solid state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature.
b. Provide ballast suitable for lamp specified.
c. Voltage: As indicated.

2.4 FLUORESCENT LAMP EMERGENCY POWER SUPPLY

A. Manufacturers:

1. Bodine - B50 Series
2. Chloride - CFP8-4 Series
3. Emergi-Lite - EPSI/U Series
4. Universal - 8500 Series
5. Approved equal

B. Description: Emergency battery power supply suitable for

installation in ballast compartment of fluorescent luminaire.

C. Lamp Ratings: Two F32T8CW lamp providing 900 to 1100 initial lumens, minimum

D. Battery: Sealed nickel cadmium type, with integral charger, rated for 10 year life.

E. Include TEST switch and AC ON indicator light, installed to be operable and visible from the outside of an assembled fixture.

F. Unit to be wired so that the battery pack receives an unswitched circuit and the fixture ballasts receives the switched circuit. The emergency battery pack shall illuminate the required lamps only under power failure regardless of the switch position. Provide night lights (continuously burning lamps) only where indicated as night lights.

2.5 LAMPS

A. Incandescent Lamp:

1. Manufacturers:
   a. General Electric
   b. Sylvania
   c. Phillips
   d. Approved equal

2. Description: 120 volt, inside frosted or reflector type.

B. Fluorescent Lamps:

1. Manufacturers:
   a. General Electric
   b. Sylvania
   c. Phillips
   d. Approved equal

2. Description: T8, rapid start type, medium bipin, 4100

degree K, minimum color rendering index of 75.

C. Compact Fluorescent Lamps

1. Manufacturers:
   a. General Electric
   b. Sylvania
   c. Phillips
   d. Approved equal

2. Description: Twin or quad tube, 3500-4100 degree K.

D. High Intensity Discharge (HID) Lamp:

1. Manufacturers:
   a. General Electric
   b. Sylvania
   c. Phillips
   d. Venture
   e. Approved equal

2. Description:
   a. Metal Halide - Phosphered type.
   b. High Pressure Sodium - Diffuser coated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturers instructions.

B. Install the fixtures where indicated, but make adjustments using the same numbers of fixtures in accordance with the Architectural reflected ceiling plan where ceilings exist and verified to be compatible with system.

C. Where suspended ceilings are involved, coordinate recessed fixture types and trims with actual installed ceiling system, and provide all necessary frames and trim to properly complete each particular installation.

D. Support luminaires larger than 600 mm x 1200 mm size independent of ceiling framing.

E. Install wall mounted fixtures, emergency lighting units and exit signs at height indicated on Drawings.

F. Install accessories furnished with each fixture.

G. Connect fixtures and emergency lighting units to branch circuits using flexible conduit.

H. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture.

I. Bond fixtures and metal accessories to branch circuit equipment grounding conductor.

J. Install specified lamps in each fixture, emergency lighting unit and exit sign.

K. Recessed lay-in type fluorescent fixtures shall be secured to the ceiling tee bar by running a self-tapping screw through the vertical part of the tee bar main runners only and the fixture at each of the four corners of the fixture. In addition, support the fixture from the structure above with two 12 gauge steel wires attached to the fixture at diagonally opposite corners.

L. Surface and wall mounted fixtures shall be secured with a minimum of four bolts or screws. Do not use clips or fasteners. The bolts or screws shall be run through or into a structural member, slab, stud or other support added for this purpose. Do not secure or support the weight of the fixtures from gypboard on walls or any ceiling material. Fixtures attached to ceiling tees shall be attached to the main runners only with at least two positive clamping devices such as U-bolts. Rotational spring catches or other clips shall not be used. A 12 gauge steel wire shall be attached to each clamping device and to the structure above.

M. Where fluorescent fixtures are suspended with chain hangers, the hangers shall be secured to the fixture and the structure with screws or bolts. Do not use clips or fasteners.

N. Recessed flanged type fluorescent fixtures shall be secured using adjustable swing-gate type hangers that fit over the ceiling support member around the opening and adjusted to secure the fixture flange tight against the ceiling. The hangers shall be adjustable from inside the fixture and a minimum four shall be provided for each fixture. A self-tapping screw shall be run through the end cap of the fixture and the vertical part of the ceiling framing at each of the four corners of the fixture. In addition, support the fixture from the structure above with two 12 gauge steel wires attached to the fixture at diagonally opposite corners.

O. Recessed incandescent, compact fluorescent and H.I.D. fixtures installed in lay-in type ceilings shall be supported from the tee bar system using suspension bar hangers designed for the purpose that fasten to the vertical part of the tee bar. Support the fixture from the main runners only. Do not secure to or support the weight of the fixture from the ceiling material. Secure the bar hanger to the tee by running a self-tapping screw through the vertical part of the ceiling tee and the fastener on each end of the bar hanger.

In addition support the fixture from the structure above with one 12 gauge steel wire attached to the fixture at a point as near to the center as possible.

P. Recessed incandescent, compact fluorescent and H.I.D. fixtures installed in non-lay-in type ceilings shall be supported from the ceiling support system using suspension bar hangers designed for the purpose that fasten to the support system. Do not secure to or support the weight of the fixture from the ceiling material. Secure the bar hanger to the support system by running a self-tapping screw through the vertical part of the ceiling support and the fastener on each end of the bar hanger. In addition support the fixture from the structure above with one 12 gauge steel wire attached to the fixture at a point as near the center as

possible.

Q. Fixtures recessed in walls shall be secured with a minimum of four bolts or screws. Do not use clips or fasteners. The bolts or screws shall be run through or into a structural member, stud or other support added for the purpose. Do not secure or support the weight of the fixture from gypboard on walls. Provide two screws on opposite sides or top and bottom of the fixture.

R. Exit signs shall be secured to an outlet box with a minimum of two screws. The outlet box shall be secured as specified in Section 16130.

S. Surface and wall mounted fixtures larger than 200 mm in any dimension or weights more than 1.8 kg shall be supported independently of the outlet box and secured with a minimum of four bolts or screws. Do not use clips or fasteners. The bolts or screws shall be run through or into a structural member, concrete or masonry wall, or ceiling support member, stud or other support added for this purpose. Do not secure or support the weight of the fixture from gypboard on walls or any ceiling material. Smaller fixtures shall be supported from the outlet box and secured with a minimum of two screws. The outlet box shall be secured as specified in Section 16130. Fixtures attached to ceiling tees shall be attached to the main runners only with at least two positive clamping devices. Rotational spring catches or other clips shall not be used. A 12 gauge steel wire shall be attached to each clamping device and to the structure above.

3.2 FIELD QUALITY CONTROL

A. Operate each fixture after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

A. Aim and adjust luminaires as directed.

B. Adjust exit sign directional arrows as indicated.

C. Relamp luminaires at Substantial Completion.

3.4 CLEANING

A. Remove dirt and debris from enclosure.

B. Clean lenses and reflector surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

END OF SECTION

SECTION 16528

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code
ANSI C78.1375	(1990) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1990) 1000-Watt, M47 Single-Ended Metal-Halide Lamps
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C135.1	(1979) Galvanized Steel Bolts and Nuts for Overhead Line Construction
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction
ANSI C136.2	(1985) Luminaires Voltage Classification
ANSI C136.3	(1989) Luminaire Attachments - for Roadway Lighting Equipment
ANSI C136.6	(1990) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies - Mechanical and Optical Interchangeability
ANSI C136.9	(1990) Roadway Lighting Equipment - Socket Support Assemblies for Metal Heads - Mechanical Interchangeability
ANSI C136.11	(1988) Multiple Sockets for Roadway Lighting Equipment
ANSI C136.13	(1992) Metal Brackets for Wood Poles
ANSI C136.15	(1986) High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaires - Field Identification

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 575	(1989) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA ARP-8	(1983) Roadway Lighting

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 98	(1994; Rev Feb 1995) Enclosed and Dead-Front Switches
UL 486B	(1991; Rev thru Apr 1992) Wire Connections for Use with Aluminum Conductors
UL 1029	(1994) High-Intensity-Discharge Lamp Ballasts
UL 1572	(1991; Rev thru Jul 1994) High Intensity Discharge Lighting Fixtures

1.2 SYSTEM DESCRIPTION

1.2.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.2.2 NOT USED

1.2.3 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.2.4 NOT USED

1.2.5 NOT USED

1.2.6 NOT USED

1.2.7 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.2.8 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.2.9 NOT USED

1.2.10 NOT USED

1.2.11 Protection of Security Lighting System Components

1.2.11.1 Components and Conductors

Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire guards shall be provided to protect security lighting luminaries mounted below 6.1 m.

1.3 CORROSION PROTECTION

1.3.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

1.3.2 Ferrous Metal Materials

1.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

1.3.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat

to the metal surface in excess of 1.6 mm from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

1.4 SUBMITTALS

Submit under provisions of Section 01300. Refer to Section 16010.

Data

Equipment and Materials.

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

Spare Parts.

Spare parts data for each item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

Drawings

Lighting System; GA.

Detail drawings for the complete system and for poles, lighting fixtures, bracket arms, handholes. Drawings shall indicate bonding method for concrete encasement. For lighting, data shall include:

a. Lamp strike and restrike times.

b. A typical zone layout showing light locations, isolux patterns, and lighting ratios.

c. Point by point layout showing light locations, and lux valves at 5 m intervals.

As-Built Drawings

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

Reports

Operating Test; GA.

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Ground Resistance Measurements

The measured resistance to ground of each separate grounding installation, indicating the location of the rods, the resistance of the soil in ohms per millimeter and the soil conditions at the time the measurements were made. The information shall be in writing.

Operation and Maintenance Manuals

Lighting System.

A draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 BRACKET ARMS

2.2.1 On Aluminum Poles

Poles shall be provided with bracket arms of the support arm style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with ANSI C136.13.

2.2.2 NOT USED

2.2.3 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 POLES

2.11.1 Aluminum Poles

Aluminum poles and brackets for lighting shall have a finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

a. Shafts shall be square and of seamless construction. The wall thickness shall be at least 4.8 mm (0.188 in). Exterior surfaces shall be free of protuberances, dents, cracks, and discoloration. Material for shafts shall be 6063 aluminum alloy; after fabrication, the alloy shall have a T6 temper. Tops of shafts shall be fitted with a round or tapered cover. Bases shall be anchor bolt mounted, made of cast aluminum alloy 356-T6, and shall be machined to receive the lower end of shafts. Joints between shafts and bases shall be welded. Bases shall be provided with four holes, spaced 90 degrees apart, for anchorage.

b. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

2.11.2 NOT USED

2.11.3 NOT USED

2.11.4 NOT USED

2.11.5 NOT USED

2.11.6 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.12 POLE LINE HARDWARE

Zinc coated hardware shall conform to ANSI C135.1 and ANSI C135.14, and steel hardware material shall conform to ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153.

2.13 NOT USED

2.14 NOT USED

2.15 ILLUMINATION

2.15.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for general area and security lighting, including floodlighting shall be in accordance with the details on the plans.

2.16 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

2.16.1 NOT USED

2.16.2 NOT USED

2.16.3 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI C78.1375 or ANSI C78.1376. Ballasts shall conform to ANSI C82.4or UL 1029.

2.17 NOT USED

2.18 NOT USED

2.19 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.20 LIGHTING CONTROL EQUIPMENT

2.20.1 NOT USED

2.20.2 NOT USED

2.20.3 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.21 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA ARP-8.

2.22 LUMINAIRES, FLOODLIGHTING

2.22.1 HID

HID lighting fixtures shall conform to UL 1572.

2.23 FIXTURES

Standard fixtures shall be as detailed on plans. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

2.23.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.23.2 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special Type 1.

2.23.3 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated at 30 amperes, 600 volts, with insulated boots. Fuse rating shall be 600 volts as indicated.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government. The Contractor shall not take any corrective action without written permission from the Government.

3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.3 PREVENTION OF CORROSION

3.3.1 Aluminum

Aluminum shall not be used in contact with earth or concrete, and where connected to dissimilar metal, shall be protected by approved fittings and treatment.

3.3.2 NOT USED

3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 CABLE INSTALLATION

3.4.1 NOT USED

3.4.2 Installation in Duct Lines

Ground and neutral conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.4.3 NOT USED

3.4.3.1 NOT USED

3.4.3.2 NOT USED

3.4.3.3 NOT USED

3.4.3.4 Markers

Cable and cable splice markers shall be located near the ends of cables, at each cable splice, approximately every 120 m along the cable run, and at changes in direction of the cable run. Markers need not be placed along cables laid in relatively straight lines between lighting poles that are spaced less than 120 m apart. Markers shall be placed approximately 600 mm to the right of the cable or cable splice when facing the longitudinal axis of the cable in the direction of the electrical load. The marker shall be concrete with a 28 day compressive strength of 17 MPa (2500 psi) in accordance with Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. The letter "C" shall be impressed in the top of each marker.

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 NOT USED

3.10 NOT USED

3.11 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of 9.1 m. Electrical cabling shall be provided to the light pole as specified in Section 16123. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and ANSI C2. Poles shall be set straight and plumb.

3.11.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site.

3.11.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Concrete shall be 21 MPa at 28 days.

3.11.3 NOT USED

3.11.4 NOT USED

3.11.5 Aluminum, Steel, Fiberglass and Concrete Pole Installation

Poles shall be mounted on cast-in-place foundations. Conduit elbows shall be provided for cable entrances into pole interiors.

3.11.5.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufactures standard, and not less than necessary to meet the pole wind loading and other specified design requirements.

3.12 LIGHTING

3.12.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.12.2 Fixture Installation

Standard fixtures shall be installed as detailed on plans. Illustrations shown on these sheets or on the drawings are indicative of the general type

desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light-distribution and brightness characteristics, and equal finish and quality will be acceptable as approved.

3.12.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

3.12.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

3.13 NOT USED

3.14 LIGHTING CONTROL SYSTEM

3.14.1 NOT USED

3.14.2 NOT USED

3.14.3 Manual and Safety Switches

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm bolts. The use of sheet metal screws will not be allowed.

3.15 GROUNDING

3.15.1 NOT USED

3.15.2 NOT USED

3.15.3 Lighting Pole

One ground rod shall be provided at each pole. Bases of metal or concrete lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire. Lighting fixture brackets on wood and concrete poles shall be grounded to a No. 6 AWG bare copper grounding conductor connected to the ground rod.

3.16 TESTS

3.16.1 NOT USED

3.16.2 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

3.16.3 Ground Resistance Measurements

The resistance to ground shall be measured by the fall-of-potential method

described in IEEE Std 81.

The contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "as-built" drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the lighting system. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the as-built drawings, a representative of the Government will review the as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and shall complete the work as required.

-- End of Section --

SECTION 16670

LIGHTNING PROTECTION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air terminals and interconnecting conductors.

B. Grounding and bonding for lightning protection.

1.2 RELATED SECTIONS

A. Section 07105: Roofing system.

B. Section 16010 - General Provisions - Electrical.

C. Section 16111 - Conduit.

D. Section 16170 - Grounding and Bonding.

E. Section 16190 - Supporting Devices.

F. Section 16530 - Exterior Lighting.

1.3 CODES AND STANDARDS

A. LPI-175 - Lightning Protection Installation Standard.

B. LPI-176 - Lightning Protection System Material and Components Standard.

C. LPI-177 - Inspection Guide for LPI Certified Systems.

D. NFPA 780 - Lightning Protection Code.

E. UL 96 - Lightning Protection Components.

F. UL 96A - Installation Requirements for Lightning Protection Systems.

1.4 SYSTEM DESCRIPTION

A. Lightning Protection System: UL Class 1 Conductor system protecting the structures consisting of air terminals on roofs, roof-mounted mechanical equipment, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors.

1.5 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Shop Drawings: Indicate layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details. Shop drawings shall be provided by the material manufacturer.

B. Data Sheets: Provide dimensions and materials of each component, and include indication of listing in accordance with UL 96.

1.6 PROJECT RECORD DOCUMENTS

A. Refer to Section 16010.

B. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors on project record documents and/or manufacturer's shop drawings.

1.7 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Maintenance Data: Submittal data sheets and shop drawings.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 780 and other codes and standards listed in Section 16010.

Modular Design System

B. Perform Work in accordance with UL 96A and provide Master Label.

C. Perform Work in accordance with LPI-175 and provide LPI Certification.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in lightning protection equipment with minimum five years documented experience.

B. Installer: Authorized installer of manufacturer with minimum five years documented experience.

1.10 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 and 780.

B. Furnish products listed and classified by UL as suitable for the purpose specified and indicated. Products shall bear the UL Label.

1.11 FIELD MEASUREMENTS

A. Verify measurements indicated on shop drawings.

1.12 COORDINATION

A. Coordinate work with roofing and exterior and interior finish materials and installations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. A.C. Lightning Security

B. Heary Brothers Lightning Protection

C. Robbins Lightning Protection

D. Thompson Lightning Protection Inc.

E. Approved equal.

2.2 COMPONENTS

A. Air Terminals: these shall be 9 mm minimum diameter solid bar copper bar. The length shall be 610 mm long or as indicated. They shall have a tapered point and a threaded end for connection to an air terminal base. Tubular air terminals are not acceptable.

B. Main Conductors: There shall be copper.

Modular Design System

1. Copper conductors shall be bare electrical grade copper cable of a minimum 29 strands, 14 AWG wire, 320 lbs/1000 ft., 115,000 CM.

C. Secondary bonding conductors: These shall be copper.

1. Copper conductors shall be electrical grade bare copper cable of a minimum 29 strands, 17 AWG, 190 lbs/1000 ft., 59,500 CM.

D. All devices shall have bolt pressure cable connectors with a minimum of 38 mm of cable contact and stainless steel bolts. Devices with crimp type cable connectors are not acceptable, except where specified.

E. Air Terminal Bases: These shall be cast copper or as indicated with a cable connector. Provide swivel air terminal connectors or adjustable bases for mounting on sloped surfaces.

F. Structural Steel Bonding Plates: These shall be cast copper, or as indicated with a cable connector. The plate shall have a minimum bonding contact area of 5000 sq mm and holes for four 8 mm bolts for mounting.

G. Primary and Secondary Bonding Plates: These shall be cast copper, or as indicated with a cable connector. The plate shall have a minimum bonding contact area of 1875 sq mm and holes for two 6 mm mounting bolts or screws.

H. Bus Terminals: These shall be cast or forged copper, or as indicated with a cable connector. Terminal shall have a minimum bonding contact area of four times the cable size and a hole for one 6 mm mounting bolts or screw.

I. Pipe and Conduit Bonding Clamps: These shall be cast copper, or as indicated with a cable connector. Bronze clamps shall be lead tinned covered. Aluminum clamps shall be bare. The clamp shall provide a minimum of 38 mm of cable and pipe contact along the axis and the minimum or greater contact area as per the herebefore mentioned code and standards.

Clamps shall be the proper size and design for the pipe or conduit to which they are connected. U-bolt type clamps are acceptable.

J. Pipe and Conduit Bonding Straps: These shall be copper or as indicated, adjustable type with a cast cable connector. Copper straps shall be lead tinned covered. Straps shall be a minimum of 38 mm wide for connections to all pipes and conduits at the service entrances to the building and all water pipe connections. Straps shall be a minimum of 25 mm wide for all pipes and conduits that penetrate the roof except water pipes. Cable connectors shall be cast bronze or as required. All straps shall provide the minimum or greater contact area as required by the herebefore mentioned codes and standards.

K. Cable Splicers and Connectors: Single metal type shall be cast copper. Bimetal type shall be cast bronze or brass and aluminum or stainless steel. Both types shall have a minimum of 50 mm of cable contact for each leg. They shall be pull rated for 9 kg.

L. Thru-Roof and Thru-Wall Cable Fittings: These shall include a stainless steel threaded rod with cast copper or cable connectors on each end as required. The length shall be as required. All nuts and washers shall be stainless steel. Provide proper flashing or sealing devices.

M. Air Terminal Braces: These shall be tripod type with 6 mm mild steel legs and heavy section washer guides. All joints shall be welded. The feet shall be annealed to permit shaping. The brace shall be hot galvanized after assembly. Bolt down type feet shall have holes for two 6 mm bolts per foot. Adhesive type feet shall have adhesive plates.

N. Conduit Bonding Wedges: These shall be copper, or as required and sized as required to fit conduit used and make a tight bond between conductor and the conduit.

O. Ground Rods: These shall be copper clad steel, 19 mm,

minimum diameter and 3 m long sectional type with tapered point and threaded end. Where rod sections are required to be connected, they shall be connected with high strength copper alloy or bronze couplers, or by exothermic welds.

P. Exothermic Welds: These shall be made by an exothermic process which produces molecular bonding of the conductors and ground rods or other objects to which they are connected. They shall be approved for exposure to the elements or direct burial without degradation. The welds shall be made using graphite molds which are the proper size and design for the conductors and other objects to be welded and the type of weld configuration. The weld material shall be a copper oxide and aluminum mixture with a minimum 3 percent tin. The starting material shall consist of aluminum and copper and iron oxides and can be only ignited by a spark ignitor designed for that purpose. It shall not contain phosphorous or any caustic, toxic, or explosive substance. Provide all proper tools and miscellaneous devices required. All of the welding components shall be of the same manufacturer.

Q. Cable Fasteners: for fastening to wood, masonry and metal, these shall be heavy gauge stamped copper loop or strap type and sized as required. For fastening to built-up and single membrane roof material, these shall be heavy gauge stamped copper crimp type with an adhesive base.

R. Miscellaneous bolts, nuts and screws: These shall be brass, aluminum or stainless steel and sized as required.

S. Adhesives: These shall be a type approved by the manufacturer of the lightning protection equipment and the roof material manufacturer. A letter of approval from the lightning protection equipment and the roof material manufacturers shall be obtained and submitted with the product submittals.

PART 3 EXECUTION

3.1 INSTALLATION

Modular Design System

A. Install in accordance with NFPA 780, UL 96A, and LPI-175 and the manufacturer's shop drawings and written instructions.

B. All connections to counterpoise, ground rods and other non-accessible devices below grade shall be made by exothermic welds.

3.2 FIELD QUALITY CONTROL

A. The system shall be tested in accordance with NFPA 780, UL 96A and LPI-175. Resistance value shall not exceed 10 ohms. Provide additional ground rod sections to achieve resistance values.

B. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and labeling of the lightning protection system in accordance with UL 96A.

C. Obtain the services of the Lightning Protection Institute to provide inspection and certification of lightning protection system in accordance with LPI-177.

END OF SECTION

SECTION 16640

CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0169	(1992) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(1981; Rev thru Dec, 1992) Rigid Metal Conduit
UL 510	(1986; Rev Oct 1986) Insulating Tape
UL 514A	(1991) Metallic Outlet Boxes

1.2 GENERAL REQUIREMENTS

1.2.1 Services of Corrosion Engineer

The Contractor shall obtain the services of a corrosion engineer to supervise and to inspect the installation of the cathodic protection system. Corrosion Engineer refers to a person, who, by reason of his knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control on buried or submerged metallic piping systems and metallic tanks. Such person may be a licensed professional engineer or may be a person certified as being qualified by the National Association`of Corrosion Engineers if such licensing or certification includes suitable experience in corrosion control on buried or submerged metallic piping systems and metallic tanks. The corrosion engineer shall insure that the cathodic protection system is installed, tested, and placed into service in accordance with the requirements specified.

1.2.2 Rules

The installation shall conform to the applicable rules of NFPA 70.

1.3 SUBMITTALS

Submit under provisions of Section 01300. Refer to Section 16010.

Data

Cathodic Protection System.

Manufacturer's Catalog Data.

Qualifications.

Evidence of qualifications of the corrosion engineer.

Drawings

Cathodic Protection System.

Detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function properly as a unit.

Reports

Tests and Measurements.

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system.

PART 2 PRODUCTS

2.1 ANODES

2.1.1 Magnesium Anodes

Magnesium anodes shall be magnesium-manganese corresponding to the applicable chemical composition listed in the following table:

PERCENT BY WEIGHT

ELEMENT	TYPE I	TYPE II	TYPE III	MG-MN ALLOY
Aluminum	5.0 - 7.0	5.3 - 6.7	5.3 - 6.7	0.010 Max.
Zinc	2.0 - 4.0	2.5 - 3.5	2.5 - 3.5	
Manganese	0.15 Min.	0.15 Min.	0.15 Min.	0.50 - 1.30
Copper	0.1 Max.	0.05 Max.	0.02 Max.	0.02 Max.
Silicon	0.30 Max.	0.30 Max.	0.10 Max.	
Iron	0.003 Max.	0.003 Max.	0.003 Max.	0.03 Max.
Nickel	0.003 Max.	0.003 Max.	0.002 Max.	0.001 Max.
Others	0.30 Max.	0.30 Max.	0.30 Max.	0.05 each or 0.30 Max. Total
Magnesium	Balance	Balance	Balance	Balance

PERCENT BY WEIGHT

ELEMENT	TYPE I	TYPE II	TYPE III	MG-MN ALLOY

2.1.2 NOT USED

2.1.3 Connecting Wire

Wire shall be No. 12 AWG solid copper wire, not less than 3 m long, unspliced, complying with NFPA 70, Type [TW] [RHH] insulation. Connecting wires for magnesium anodes shall be factory installed with the place of emergence from the anode in a cavity sealed flush with a dielectric sealing compound.

2.1.4 Artificial Backfill

Anodes shall be factory packaged with an artificial backfill in a water permeable fabric sack or cardboard container. Anodes shall be packaged on a vibrating platform to attain dense packing, and centering shall be assured by means of spacers.

Artificial backfill shall have the following composition:

Material	Approximate Percent by Weight
Gypsum	75
Bentonite	20
Sodium Sulfate	5
Total	100

2.2 MISCELLANEOUS MATERIALS

2.2.1 Electrical Wire

Wire shall be No. [_____] AWG stranded copper wire with NFPA 70, Type [TW] [RHW-USE] [RHW-USE] [_____] insulation. Connecting wire splicing shall be copper compression connections made for the purpose or exothermic welds following instructions of the manufacturer. Split-bolt connections shall not be used.

2.2.2 Conduit

Rigid galvanized steel conduit and accessories shall conform to UL 6. Non metallic conduit shall conform to NEMA TC 2.

2.2.3 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

2.2.4 Joint, Patch, Seal, and Repair Coating

Sealing and dielectric compound shall be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound shall be applied as recommended by the manufacturer, but not less than 12.7 mm thick.

Coating compound shall be [cold-applied coal-tar base mastic] [hot-applied coal-tar enamel] [an approved pipeline wrapping].

Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.2.5 Preformed Sheaths

Sheaths for encapsulating electrical wire splices to be buried underground shall fit the insulated wires entering the spliced joint.

2.2.6 Epoxy Potting Compound

Compound for encapsulating electrical wire splices to be buried underground shall be a two package system made for the purpose.

2.2.7 Test Stations

Test stations shall be complete with an insulated terminal block having the indicated number of terminals and shall be provided with a lockable cover [and have a cast-in legend, "C.P. Test"].

PART 3 EXECUTION

3.1 INSTALLATION

Unless otherwise indicated, all equipment shall be installed in accordance with the manufacturer's recommendations.

3.1.1 Anode Installation

Anodes of the size indicated shall be installed at the locations shown. Locations may be changed to clear obstructions if approved. Anodes shall be installed as indicated in a dry condition after any plastic or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire shall not be used for lowering the anode into the hole. The annular space around the anode shall be backfilled with fine earth in 150 mm layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 20 liters of water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 150 mm above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

Single anodes spaced as shown shall be [direct connected] [connected through a test station] to the pipeline, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.

Groups of anodes in quantity and location shown shall be connected to a collector cable. The collector cable shall make contact with the structure to be protected only through a test station.

Resistance wires shall not be used to reduce the current output of individual or group anodes.

Connections to [ferrous pipe] [metal tanks] shall be made by exothermic weld methods manufactured for the type of [pipe] [tank].

Electric arc welded connections and other types of welded connections to

ferrous pipe and structures shall be approved before use.

3.1.2 Test Stations

Test stations shall be of the type and location shown and shall be [curb box] [post] [indoor] mounted. Buried electrically insulating joints shall be provided with test wire connections brought to a test station. Unless otherwise shown, other test stations shall be located as follows:

a. At 300 m intervals or less.

b. Where the pipe or conduit crosses any other metal pipe.

c. At both ends of casings under roadways and railways.

d. Where both sides of an insulating joint are not accessible above ground for testing purposes.

3.2 CRITERIA OF PROTECTION

Criteria for determining the adequacy of protection on a buried [pipe] [tank] shall be in accordance with NACE RP0169 and shall be selected by the corrosion engineer as applicable.

3.2.1 Iron and Steel

One of the following methods shall apply:

3.2.1.1 850 MV Negative Voltage

A negative voltage of at least minus 0.85 volt as measured between the [pipe] [tank] and a saturated copper-copper sulfate reference electrode contacting the earth directly over the [pipe] [tank]. Determination of this voltage shall be made with the cathodic system in operation.

3.2.1.2 300 MV Negative Voltage

A negative voltage shift of at least 300 millivolts as measured between the [pipe] [tank] and a saturated copper-copper sulfate reference electrode contacting the earth directly over the [pipe] [tank]. Determination of this voltage shift shall be made with the protective current applied. These criteria apply to [pipes] [tanks] not in electrical contact with dissimilar metals.

3.2.1.3 100 MV Polarization Voltage

A minimum polarization voltage shift of 100 millivolts as measured between the [pipe] [tank] and a saturated copper-copper sulfate reference electrode contacting the earth directly over the [pipe] [tank]. This polarization voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. When the protective current is interrupted, an immediate voltage shift will occur. The voltage reading, after the immediate shift, shall be used as the base reading from which to measure polarization decay.

3.2.2 Aluminum

Aluminum [pipes] [tanks] shall under no circumstances be protected to a potential more negative than minus 1.20 volts, measured between the [pipe]

[tank] and a saturated copper-copper sulfate reference electrode contacting the earth, directly over the [pipe] [tank]. Resistance, if required, shall be inserted in the anode circuit within the test station to reduce the potential of the aluminum [pipe] [tank] to a value which will not exceed a potential more negative than minus 1.20 volts. Voltage shift criterion shall be one of the following:

3.2.2.1 150 MV Negative Voltage

A minimum negative voltage shift of 150 millivolts produced by the application of protective current. The voltage shift shall be measured between the [pipe] [tank] and a saturated copper-copper sulfate reference electrode contacting the earth directly over the [pipe] [tank].

3.2.2.2 100 MV Negative Voltage

A minimum negative polarization voltage shift of 100 millivolts measured between the [pipe] [tank] and a saturated copper-copper sulfate reference electrode contacting the earth, directly over the [pipe] [tank]. The polarization voltage shift shall be determined as outlined for iron and steel.

3.3 TESTS AND MEASUREMENTS

3.3.1 Baseline Potentials

After backfill of the [pipe] [tank] and anodes is completed, but before the anodes are connected to the [pipe] [tank], the static potential-to-soil of the [pipe] [tank] shall be measured. The locations of these measurements shall be identical to the locations specified for [pipe-] [tank-] to-reference electrode potential measurements. The initial measurements shall be recorded.

3.3.2 Insulation Testing

Before the anode system is connected to the [pipe] [tank], an insulation test shall be made at each insulating joint or fitting. This test shall demonstrate that no metallic contact, or short circuit exists between the two insulated sections of the [pipe] [tank]. Any insulating fittings installed and found to be defective shall be reported to the Contracting Officer.

3.3.3 Anode Output

As the anodes or groups of anodes are connected to the [pipe] [tank], current output shall be measured with an approved low resistance ammeter. The values obtained and the date, time, and location shall be recorded.

3.3.4 [Pipe-] [Tank-] To-Reference Electrode Potential Measurements

Upon completion of the installation and with the entire cathodic protection system in operation, electrode potential measurements shall be made using a copper-copper sulfate reference electrode and a potentiometer-voltmeter, or a direct current voltmeter having an internal resistance (sensitivity) of not less than 100,000 ohms per volt and a full scale of 1 or 2 volts. The locations of these measurements shall be identical to the locations used for the baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded.

3.3.5 Location of Measurements

3.3.5.1 Piping or Conduit

For coated piping or conduit, measurements shall be taken from the reference electrode located in contact with the earth, directly over the pipe. Connection to the pipe shall be made at service risers, valves, test leads, or by other means suitable for test purposes. Measurements shall be made at intervals not exceeding 120 m. In no case shall less than three measurements be made over any length of line. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line.

3.3.5.2 Tanks

For underground tanks measurements shall be taken from the reference electrode located:

a. Directly over the center of the tank.

b. At a point directly over the tank and midway between each pair of anodes.

c. At each end of the tank.

In no case shall less than three measurements be made.

3.3.6 Casing Tests

Casing tests before final acceptance of the installation, the electrical separation of carrier pipe from casings shall be tested and any short circuits corrected.

3.3.7 Interference Testing

Before final acceptance of the installation, interference tests shall be made with respect to any foreign [pipes] [tanks] in cooperation with the owner of the foreign [pipes] [tanks]. A full report of the tests giving all details shall be made.

3.3.8 Recording Measurements

All [pipe-] [tank-] to-soil potential measurements including initial potentials where required shall be recorded. The Contractor shall locate, correct and report to the Contracting Officer any short circuits to foreign [pipes] [tanks] encountered during checkout of the installed cathodic protection system. [Pipe-] [Tank-] to-soil potential measurements are required on as many [pipes] [tanks] as necessary to determine the extent of protection or to locate short-circuits.

3.4 PIPE JOINTS

3.4.1 Electrical Continuity

Underground pipe shall be electrically continuous except at places where electrically insulating joints are specified. Pipe joined by means other than welding shall meet electrical continuity requirements. The following mechanical joints that are not factory designed to provide electrical continuity shall be bonded by installing a metallic bond across the joint.

The bonding connections shall be made by the exothermic welding process. Mechanical joints designed to provide electrical continuity shall meet manufacturer's published standards.

3.4.2 Coating

Mechanical joints and fittings of either the electrically conductive or insulating type shall be coated with an underground type dielectric coating system. Where external electrical continuity bonds are installed across mechanical joints, all bare or exposed metal, welds, bare wire and exposed coupling parts shall be coated with a coating system.

Couplings and fittings which have a low profile exterior designed to permit tape coating shall be primed and wrapped with an underground type pipe tape following recommendations of the coupling or fitting manufacturer.

Couplings and fittings that cannot be properly taped shall be enclosed in a [spaced mold manufactured for the purpose] [shroud of reinforced kraft paper] and filled with [polyurethane foam having a cellular structure that will not absorb water] [cold applied dielectric compound] [hot applied bituminous compound not exceeding 135 degrees C in application temperature].

3.5 ELECTRICAL ISOLATION OF STRUCTURES

3.5.1 Insulating Fittings

Insulating flanges and couplings shall be installed aboveground, or within manholes, wherever possible, but an insulating device that electrically separates a pipeline shall not be installed in a confined area where a combustible atmosphere may collect unless precautions are taken to prevent arcing such as by means of externally located lightning arresters, grounding cells, or other means. Insulating flanges and couplings in lines entering buildings shall be located at least 300 mm above grade or floor level. Pipelines`entering buildings either below or above ground shall be electrically isolated from the structure wall with an electrically isolating [gas tight] wall sleeve.

3.5.2 Gas Distribution Piping

Electrical isolation shall be provided at each building riser pipe to the pressure regulator, at all points where a short circuit to another structure or to a foreign structure may occur, and at other locations as indicated.

3.5.3 Electrical Isolation

[Steam,] [High Temperature,] [Chilled,] [Water,] [Line Supply and Return Piping,] [and] [Line Conduit]: electrical isolation shall be provided at each building entrance, and at other locations as indicated.

3.5.4 [Fuel,] [Gasoline,] [Storage,] and [_____] Tanks

Electrical isolation shall be provided in each pipe at the [building] [tank] as shown.

3.5.5 Copper Piping

Copper piping shall be [electrically isolated at both ends of the pipe run]

[wrapped with pipeline tape and electrically isolated at both ends].

3.6 DISSIMILAR METALS

3.6.1 Underground Dissimilar Piping

Buried piping of dissimilar metals including new and old steel piping, excepting valves, shall be electrically separated by means of electrically insulating joints at every place of connection. The insulating joint, including the pipe, shall be coated with an underground type dielectric coating for a minimum distance of 10 diameters on each side of the joint.

3.6.2 Underground Dissimilar Valves

Dissimilar ferrous valves in a buried ferrous pipeline, including the pipe, shall be coated with an underground type dielectric coating for a minimum distance of 10 diameters on each side of the valve. Brass or bronze valves shall not be used in a buried ferrous pipeline.

3.6.3 Aboveground Dissimilar Pipe and Valves

If the dissimilar metal pipe junction, including valves, is not buried and exposed to atmosphere only, the connection or valve, including the pipe, shall be coated with an underground type dielectric coating for a minimum distance of three diameters on each side of the junction.

3.7 CASING

Where a pipeline is installed in a casing under a roadway or railway, the pipeline shall be electrically insulated from the casing and annular space sealed against incursion of water.

-- End of Section --

SECTION 16721

FIRE ALARM SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire alarm control panels.

B. Manual fire alarm stations.

C. Automatic smoke and heat detectors.

D. Fire alarm signaling appliances.

E. Auxiliary fire alarm equipment.

1.2 RELATED SECTIONS

A. Section 15855 - Air Handling Units with Coils.

B. Section 15910 - Ductwork Accessories.

C. Section 15980 - HVAC control system.

D. Section 16010 - General Provisions - Electrical.

E. Section 16111 - Conduit.

F. Section 16123 - Building Wire and Cable.

G. Section 16130 - Boxes

H. Section 16170 - Grounding and Bonding

I. Section 16180 - Equipment wiring Systems

J. Section 16190 - Supporting Devices

K. Section 16195 - Electrical Identification

1.3 CODES AND STANDARDS

A. NFPA 70 - National Electrical Code.

B. NFPA 72 - National Fire Alarm Code.

C. NFPA 101 - Life Safety Code.

D. UL 268: Smoke Detectors for Fire Protective Signaling Systems.

E. UL 268A: Smoke Detectors for Duct Application. Rev. 3/86

F. UL 521: Heat Detectors for Fire Protective Signaling Systems.

G. UL 864: Control Units for fire Protective Signaling Systems.

H. SBC - Standard Building Code.

I. SFPC - Standard Fire Prevention Code.

J. UBC - Uniform Building Code.

K. BOCA - Basic National Building code.

L. Local Codes and Ordinances

1.4 SYSTEM DESCRIPTION

A. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connections to a base wide system

B. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, or to signal line circuits (SLC), Style 6, in accordance with NFPA 72. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC), Style Z in accordance with NFPA 72. A two-loop conduit system shall be provided so that if any one conduit and all conductors contained in that conduit are severed all IDC, IAC, or SLC on that circuit shall remain

functional. A two-loop system is not applicable to the central fire alarm communication center from the local panels. All textual, audible, and visual appliances and systems shall comply with NFPA 72.

1.5 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Shop Drawings: Provide annunciator layout and system wiring diagram showing each device and wiring connection required. Provide floor plans showing device locations and conduit routing and sizes. Provide detailed drawings signed by a registered PE.

B. Data Sheets: Submit as a minimum the following information on each different device, control panel, and annunciator. The information shall be in the form of the manufacturer's standard product data sheets.

1. Control Panel
   a. Manufacturer's series or catalog number
   b. Highlight or otherwise indicate the features specified.
   c. Dimensioned picture or drawings.

2. Initiating Devices
   a. Manufacturer's series or catalog number.
   b. Type of device
   c. Ratings
   d. Mounting type
   e. Mounting base
   f. Auxiliary devices
   g. Dimensioned picture or drawing

3. Signaling Devices
   a. Manufacturer's series or catalog number
   b. Type of device
   c. Ratings
   d. Mounting type
   e. Annunciator elevation and legend
   f. Dimensioned picture or drawing

4. Auxiliary Devices
    a. Manufacturer's series or catalog number
    b. Type of device
    c. Ratings
    d. Mounting type
    e. Dimensioned picture or drawing

5. Wiring
    a. List the NEC designations for the wiring to be used and what it is to be used for.

6. Radio Transceiver
    a. Manufacturer's series or catalog number: Monaco.
    b. Operation
    c. Dimensioned picture or drawing.
    d. Type of device.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, start-up and testing of the system.

D. Fire Department Review: Submit plans and specification to the local Fire Department for approval and comments.

E. Fire Department Comments: Submit Fire Department review comments.

1.6 PROJECT RECORD DOCUMENTS

A. Refer to Section 16010.

B. Record actual locations of initiating devices, signaling devices and control and annunciator panels.

1.7 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Operation Data: Operating instructions.

C. Maintenance Data: Maintenance and repair procedures, shop drawings and submittal data sheets.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standards listed in Section 16010.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience. Registered PE with a minimum of 4 years experience in the design of fire protection and detection systems.

1.10 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 and NFPA 101.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated. All products shall bear the UL Label.

1.11 COORDINATION

A. The locations of devices indicated on the drawings are approximate. Coordinate the exact location with the architectural details and equipment.

B. Coordinate the fire alarm system with the local Fire Department, Division 15 and all other appropriate Sections.

1.12 EXTRA MATERIALS

A. Provide ten manual station break-glass rods.

B. Provide six keys of each type.

C. Provide three of each type of automatic smoke detector without base.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Edward Systems Technology

B. Notifier

C. Simplex

D. Pyrotronics

E. Monaco

F. Approved equal

2.2 FIRE ALARM CONTROL PANEL

A. System Description: Zoned coded, continuously ringing, fully supervised fire alarm system. The control panel, annunciator and all devices and system components shall be UL Listed as a system. All equipment and devices shall be of the same manufacturer. Zoning shall be as indicated. The sequence of operation shall be as indicated on the drawings.

B. Control Panel: Modular microprocessor based construction with flush or surface mounted enclosure as indicated. The zone capacity shall be as indicated, expandable to 16 zones with 25 percent spare zones.

C. Power supply: Power limited; adequate to serve control panel modules, remote detectors, remote annunciators, door holders, relays, or zone modules, alarm signaling devices and power all required system functions. In addition, provide 20 percent spare capacity in the power supply for future additions to the system. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours and in addition, operate under full capacity for a minimum period of 5 minutes in an alarm condition.

Modular Design System

D. System Supervision: The system shall be fully supervised. Component or power supply failure or removal places system in trouble mode.

E. Initiating Device Circuits: Supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode but does not disable that circuit from initiating an alarm.

F. Indicating Device Circuits: Supervised march time signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable that circuit from signaling an alarm.

G. Radio Signal Transceiver: Monaco BT2-4 Transceiver, electrically supervised digital alarm communicator transmitter, capable of transmitting alarm and trouble signals via radio to base wide Monaco system.

H. Coaxial Lightning Arrestor: Monaco coaxial lightning arrester for connection between antenna and transceiver panel. Arrester is to be installed per manufacturer's recommendations.

I. Antennas: Monaco antenna for transmission of radio signals between transceiver and the central receiving station. Antenna to be mounted in accordance with manufacturer's recommendations.

J. Coaxial Cable: Monaco 50 ohm miniature RG type cable with 19 strands of Number 29 wire.

K. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts to provide accessory functions specified.

L. Provide TROUBLE ACKNOWLEDGE, DRILL, and ALARM SILENCE switch.

M. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:

Modular Design System

1. Visual and audible trouble alarm indicated by zone device address at fire alarm control panel.
2. Visual and audible trouble alarm indicated at remote annunciator panel.
3. Trouble signal transmitted to base wide system via isolated dry type coated.
4. Manual acknowledge function at fire alarm control panel silences audible trouble alarm; visual alarm is displayed until initiating failure or circuit trouble is cleared.

N. Alarm Sequence of Operation: Actuation of initiating device places circuit in alarm mode, which causes the following system operations:

1. Sound and display local fire alarm signaling devices with signal.
2. Transmit zone-coded signal to base wide system via isolated dry type coated.
3. Indicate location of alarm zone on fire alarm control panel.
4. Transmit signal to building mechanical systems to initiate shutdown of fans and damper operation.

O. Alarm Reset: System remains in alarm mode until manually reset with key-accessible reset function; system resets only if initiating circuits are out of alarm mode.

P. Lamp Test: Manual lamp test function causes alarm indication at each zone at fire alarm control panel and at annunciator panel.

Q. Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.

R. Resound on alarm which allows resounding of audible devices in the event of an alarm on a new zone.

S. Resound on trouble which allows resounding of the trouble sonalert when another trouble is indicated. Also provide a programmable trouble reminder initially set for 60 minutes. Every 60 minutes, the trouble sonalert will sound to remind

the operator that a trouble condition exists.

T. Ground fault detection in wiring.

U. Capable of supporting thirty 2 wire Smoke Detectors on all initiating circuits.

V. Alarm Silence Inhibit to limit User liability. Alarm devices shall be silenced only by authorized personnel entering a locked control cabinet and operating the proper silence switch.

W. Indicating device circuit cut out to extend system operation on battery standby.

X. Walk test for ease of system testing and maintenance. Program shall actually identify the zone being tested over the indicating device circuits. Walk test shall also be capable of the following:
   a. Support multiple walk test groups to provide system reliability. This allows a portion of the system to be tested while the rest is 100% active.
   b. Automatic abort for system integrity. If no zones within an active walk test group activate for 8 hours, the system will automatically abort the walk test.
   c. As a zone is tested, the system will indicate the number of the zone as well as whether it is in trouble or alarm.

Y. Built-in transient protection per circuit.

Z. Fully field configurable, programmable and editable.

AA. Visually indicate by English language read of the zone in alarm on an 80 character, alphanumeric, LCD display on the front of the control panel.

AB. Provide UL Listed alarm verification feature for smoke detectors only. Changing of the inhibit timing shall be field adjustable.

AC. Provide timed reactivation of mechanical upon reset.

Equipment shall be sequentially started.

AD. The control panel shall allow for loading or editing special instructions and operating sequences on site to accommodate building changes. All software operations shall be stored in a non-volatile programmable memory within the control panel. Loss of primary and secondary power shall not erase the instructions stored in memory. The system shall have the capability to store a minimum of 300 alarm or troubles in a historical data file to be used for maintenance purposes.

AE. Separate manual switches for system reset, alarm acknowledge, supervisory acknowledge, trouble acknowledge, and alarm silence.

AF. Separate LED indicators for system trouble, supervisory trouble, system alarm and power on.

AG. 26 key program interface panel.

AH. Provide transformers, fuses and auxiliary relays for central station activation, mechanical equipment control and other functions described and required for a complete working system.

AI. Provide initiating zone, alarm, RS232, and supervised input/output modules as required for a complete working system as described and indicated.

AJ. Provide in the control panel on/off/auto switches for the mechanical equipment as indicated. In the auto mode, the mechanical controls shall operate the equipment. On/off controls shall allow for manual operation of the equipment. Supervised positive feedback circuits shall be provided to indicate the actual status of the equipment. Separate LED's on the control panel shall indicate on/off status. Each switch and light shall be labeled to indicate the respective equipment. Each switch shall be labeled to indicate the respective main breaker.

2.3 INITIATING DEVICES

Modular Design System

A. Manual Station: Semi-Flush mounted, coded type, single action manual station with break-glass rod. Provide manufacturer's standard backbox.

B. Duct Mounted Smoke Detector: Photoelectric type with auxiliary SPDT relay contact, key-operated NORMAL-RESET-TEST switch, duct sampling tubes extending width of duct, and visual indication of detector actuation, in duct-mounted housing.

C. Remote Visual Indicators: LED type visual indication of smoke detector status, suitable for mounting on a standard single gang outlet box. Provide manufacturer's standard prelabeled coverplate.

D. For water pressure, Tamper and other contact type devices. Provide the number of modules as required for each sprinkler flow and tamper switch connection and other contact monitoring point as indicated on the drawings, and as required for a complete operating system in accordance with the sequence of operation and applicable codes.

E. Spot Head Detector: Combination rate-of-rise and fixed temperature, rated 57 degrees C, and temperature rate-of-rise of 8.3 degrees C.

2.4 SIGNALING DEVICES

A. Alarm Lights: ADA approved strobe lamp and flasher with red lettered "FIRE" on white background.

B. Alarm Horn Strobe: NFPA 72G, projector type, as indicated fire alarm horn strobe. Sound Rating: 87 dB at 3 m. Provide integral ADA approved strobe lamp and flasher with red lettered "FIRE" on white background.

C. Alarm Horn: NFPA 72G, projector type, as indicated for alarm horn. Sound rating: 110dB at 3m.

D. Provide the number of modules as required for a complete

operating system in accordance with the sequence of operation and applicable codes.

2.5 AUXILIARY DEVICES

A. Provide the number of modules as required at the points of control such as motor starters or controllers, sprinkler preaction valves, HVAC control electric/pneumatic (EP) switches, etc. indicated on the drawings and as required for a complete operating system in accordance with the sequence of operation and applicable codes.

2.6 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Circuits: National Electrical Code listed copper wiring, and cable of the size and type indicated on the manufacturer's shop drawings.

2.7 SOFTWARE PROGRAMMING

A. All software shall be provided to provide a complete operating system able to perform all of the items described in the sequence of operation and all graphic displays.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's shop drawings, instructions and the listed codes and standards.

B. All smoke detectors for the entire fire alarm system, including those located within the AC equipment and/or ducts, shall be furnished and wired under the Electrical Section. Smoke detectors located in the AC units and/or ducts shall be properly installed therein by the AC Section, ready for electrical connections; all other smoke detectors shall be installed by the Electrical Section.

C. Mounting heights of wall mounted devices shall be as indicated.

D. See the architectural reflected ceiling plan for the exact location of devices mounted flush in or surface mounted on the ceiling.

E. Install all fire alarm system wiring in conduit.

F. Provide all outlet and backboxes as required by the manufacturer in accordance with their specifications.

G. Mount end-of-line device box with last device or separate box adjacent to last device in circuit.

H. Mount outlet box for electric door holder to withstand 36.4 kg pulling force.

I. Make conduit and wiring connections to sprinkler pressure switches, and sprinkler valve tamper switches, and fire suppression system control panels.

J. Devices and backboxes in or on the ceiling shall be supported by the ceiling support system using support channels or hangers. the weight of the device or the backbox shall not be supported by the ceiling material.

K. A 90 degree angle bracket shall be installed on each end of each support channel with a self-tapping metal screw run through each bracket and the ceiling support tee to secure the bracket to the tee. If a support channel with a integral tee bar fastener is used, a self-tapping metal screw shall be run through each fastener and the ceiling support tee to secure it to the tee. Devices and backboxes shall be supported from the main runners only.

L. Backboxes flush mounted in gypboard and stud walls for semi-flush and wall mounted audio-visual signal devices shall be secured to the studs and/or bracing with four screws; two in top and bottom, opposite sides, or each corner of the back. Provide vertical and horizontal bracing in the wall to support the weight of the audio visual device and receive the screws.

M. Provide a bushings with an insulated throat on the ends of all conduits where they terminate in outlet or junction boxes, equipment cabinets, etc.

N. Conduit types, fittings, routing and support shall be as specified in Section 16111, 16190 and 16191.

O. Outlet and backboxes shall be supported as specified in Section 16130, 16190 and 16191 unless otherwise specified.

P. The Fire Alarm Control panel shall be secured to walls with a minimum of four bolts. Where supported on concrete, masonry or block walls, anchors or other devices designed for this purpose shall be used. Where supported on gypboard and stud walls, vertical and horizontal bracing in the wall shall be provided to support the weight of the panel and its contents and to receive the bolts or screws.

Q. Provide a laminated plastic sign attached to the front outside the control panel and annunciator with a minimum of two screws which reads "Fire Alarm Control Panel". The sign shall be white with 13 mm high red characters. Provide a separate sign of the same specification that indicates the power circuit number for the fire alarm control panel.

R. Where smoke detectors are mounted in ducts above the ceiling, mount the remote LED indicator through the ceiling, at the smoke detector location, so that it will be visible from the corridor or room. Provide a 19 mm wide by length required, laminated white plastic nameplate engraved with "Duct Smoke Detector" in 13 mm high red letters. Permanently attach the nameplate to the ceiling support grid next to the indicator.

S. All wire shall be tagged at all junction points and shall test free of grounds or crosses between conductors.

T. Final connections between equipment and system wiring shall be made under the direct supervision of a representative of the manufacturer.

U. Final connections between equipment and system wiring shall

be made under the direct supervision of a representative of the manufacturer.

V. Equipment shall be installed by a duly licensed electrical contractor or a duly licensed Fire Alarm Installer as required by local code. The equipment warranty must be provided by a licensed Fire Alarm Supplier.

W. The covers of all pull boxes and junction boxes in the conduit system for the fire alarm system shall be painted red to identify them.

X. Provide tamper switches on all junction boxes mounted exposed and at or below an elevation of 2.4 m above the finished floor or grade. A trouble alarm shall be activated if the coverplate is removed.

3.2 FIELD QUALITY CONTROL

A. Following complete installation, perform all operations specified and tests in presence of the Government's, local fire Department's, and Engineer's representative. The contractor and equipment supplier shall provide all equipment and personnel to perform the tests.

B. Test in accordance with NFPA 72 and local fire department requirements.

3.3 MANUFACTURER'S FIELD SERVICES

A. Include services of certified technician to supervise installation, adjustments, final connections, check-out, and system testing.

3.4 OWNER ORIENTATION AND INSTRUCTION

A. A representative of the fire alarm system manufacturer shall meet with representatives of the Government at the time of the final acceptance of the system and shall train the Government's representatives in the operation of the system and review the operation and maintenance manuals to be

provided to the Government and recommend maintenance procedures.

END OF SECTION

SECTION 16726

VAULT INTRUSION DETECTION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The work under this section of the specifications covers all materials, labor, equipment and supplies necessary to furnish and install a complete Intrusion Detection System as described herein and shown on the drawings.

B. Section Includes: Signaling devices, intrusion detection devices, alarm control panel.

1.2 RELATED SECTIONS

A. Section 16010 - General Provisions - electrical

B. Section 16111 - Conduit

C. Section 16123 - Building Wire and Cable.

D. Section 16130 - Boxes

E. Section 16170 - Grounding and Bonding

F. Section 16190 - Supporting Devices

G. Section 16195 - Electrical Identification

1.3 CODES AND STANDARDS

A. NFPA 70 - National Electrical Code.

B. UL 634 - Connectors and Switches for Use With Burglar Alarm Systems.

C. UL 639 - Intrusion Detection Units.

D. UL 1037 - Antitheft Alarms and Devices.

1.4 SUBMITTALS: Submit under provisions of Section 01300. Refer to Section 16010.

A. Standard Products: All materials and equipment shall be new and unused. Unless specifically approved by the Contracting Officer, all ordinarily supplied as a product item by manufacturers regularly engaged in the production of such equipment. They shall be manufacturers' latest standard designs current at the time of delivery, modified only to the extent necessary to comply with the requirements of these specifications. All same-type equipment must be supplied from the same manufacturer. However, different manufacturers may be used to supply different types of equipment. In any case, all equipment must be compatible, and is required to be shown compatible if from different manufacturers. Manufacturers shall be so established in the industry that prompt and continuing service and delivery of spare parts may be assured.

B. Shop Drawings: Indicate system wiring showing each device and wiring connection required. A complete schematic wiring diagram shall be submitted identifying each system component in its relative location with the number, size, identification, and types of conductors required for interconnection of system components.

C. Equipment Lists: Prior to delivery of any materials or equipment to the job, the Contractor shall submit to the Contracting Officer a complete schedule of all units and/or equipment which he proposes to incorporate in the Intrusion Detection System. This schedule shall include catalog numbers, diagrams, drawings, reports, certifications, and other descriptive data. Manufacturer shall provide certification stating the equipment used under this contract is Underwriters' Laboratories listed for burglar alarm use. Suppliers' certifications are not acceptable. Specific data shall be provided to indicate the features utilized to minimize vulnerability to countermeasures. Any materials, components or equipment which do not comply with the

specifications will be rejected unless the Contracting officer has been satisfied that suitable testing has assured that these items will meet the performance requirements of the specification and that they are suitable, reliable, and compatible with items specified herein.

D. Data Sheets: Submit as a minimum the following information on each different device, control panel, and annunciator. The information shall be in the form of the manufacturer's standard product data sheets.

1. Control Panel
   a. Manufacturer's series or catalog number.
   b. Highlight or otherwise indicate the features specified.
   c. Dimensioned picture or drawing.

2. Initiating Devices
   a. Manufacturer's series or catalog number
   b. Type of device
   c. Ratings
   d. Mounting type
   e. Mounting base
   f. Auxiliary devices
   g. Dimensioned picture or drawing

3. Signaling Devices
   a. Manufacturer's series or catalog number
   b. Type of device
   c. Ratings
   d. Mounting type
   e. Annunciator elevation and legend
   f. Dimensioned picture or drawing

4. Auxiliary Devices
   a. Manufacturer's series or catalog number
   b. Type of device
   c. Ratings
   d. Mounting type
   e. Dimensioned picture or drawing

5. Wiring
   a. List the NEC designations for the wiring to be used and what it is to be used for.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and testing of the system.

1.5 PROJECT RECORD DOCUMENTS

A. Refer to Section 16010.

B. As-Installed Drawings: Upon completion of the work, the contractor shall neatly modify the approved shop drawings to show details of the system as actually installed. Three prints of such drawings shall be furnished to the Contracting Officer.

1.6 OPERATION AND MAINTENANCE DATA

A. Refer to Section 16010.

B. Operating and Maintenance Manual: The contractor shall furnish three copies of a technical manual containing complete operating and maintenance instructions for the Intrusion Detection System. This manual shall be prepared in a manner and form to provide technical data required by trained personnel to operate, test, and maintain the system. Drawings, schematics, tables, charts, and photographs shall be included. A draft of the manual shall be submitted for the Contracting Officer's approval as to adequacy prior to preparing in final form.

(1) Technical Section: The technical section shall contain detailed information on the equipment in the Intrusion Detection System. It shall include:

(a) General
(b) Power Supply

(c) Theory of Operation
(d) Installation
(e) Maintenance and Adjustment
(f) Troubleshooting
(g) Testing Procedures

(2) Operation Section: The operation section shall contain recommended procedures for operating the system.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with codes and standard listed in Section 16010.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Contractor shall be regularly engaged in the installation and servicing of local, remote, or central station alarm system and shall be listed by Underwriter's Laboratories for installation of alarm system.

1.9 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish Products listed and classified by UL as suitable for purpose specified and indicated. Products shall bear the UL Label.

PART 2 PRODUCTS

2.1 GENERAL

A. Drawings: The drawings indicate the extent and location of the Intrusion Detection System desired. If any departures from the drawings are deemed necessary by the contractor, details of such departures and the reasons therefore shall be

submitted for approval prior to the start of work.

B. Type of System: The Intrusion Detection System shall be of the proprietary type designed to transmit signals automatically from sensors installed in protected areas to control unit located in the protected area and thence to a local law enforcement agency (or, alternatively, a private agency possessing a 24-hour per day monitoring capability).

C. Design Concept: Design of the Intrusion Detection System and its components shall be basically conventional to insure that the system is inherently stable, reliable, and suitable for satisfactory, continuous operation. The design shall be such that it will require a minimum of maintenance and adjustments. The system shall consist of sensing units, sensing controls, central control unit, local alarm units, switching devices, necessary power, signal wiring connections, and equipment for remote notification. The system shall be suitable for connection to and operating on the available AC power.

D. Vulnerability: The detection devices, components and signal transmission equipment shall be installed as to minimize vulnerability to countermeasures.

E. Maintenance: Devices and equipment shall be designed and constructed to facilitate modular, unitized, component replacement to the maximum extent feasible without compromising the defeat resistance capability maximum extent feasible. Like units, assemblies, subassemblies, and replaceable parts shall be interchangeable as complete items. Whether subassemblies and parts are readily replaceable shall be determined by the Contracting Officer. A spare parts list with current prices shall be provided with recommended items that should be on hand.

F. Materials and Workmanship: Materials and workmanship shall be consistent with the commercial practices. Finished units shall be clean, well made, and shall be free of any defects which may affect appearance or serviceability. All edges shall be smooth, rounded and free from burrs or other

irregularities. All exposed surfaces of devices, cabinets and other items of equipment shall be thoroughly clean, dry and free from scale, oil, grease, dirt and rust. Exposed surfaces shall be painted immediately after cleaning. Ferrous surfaces shall have a rust inhibiting prime coat. Exposed ferrous surfaces shall also have at least two coats of synthetic or baked-on enable. Finish coats shall be an even surface, free of runs, sags or other blemishes.

G. Environment: All components shall be capable of full operation in relative humidity up to 90% and temperatures from 35 degrees F to 100 degrees F. Where temperatures are not controlled, each unit of equipment shall be capable of full operation in the temperature, humidity, and exposure condition as indicated on drawings for that location. In locations where temperature is below 35 degrees F, stand-by battery power supply shall be installed in a heated enclosure such that temperature is maintained within the 35 degrees F to 100 degrees F range. In locations where temperature exceeds 100 degrees F, stand-by battery power supply shall be installed in an insulated enclosure such that temperature is maintained within the 35 degrees F to 100 degrees F range or stand-by battery power supply shall be of the type designed to operate where the temperature exceeds 100 degrees F.

H. Manufacturer's Equipment Identification: Except for the manufacturer's name, no identification data is to appear on the outside of equipment covers. The model number serial numbers rating date and /or other pertinent date related to the performance of the equipment shall be indicated on a permanent name plate securely attached to the interior housing such that access to the name plate is not possible without removing the equipment cover or opening a locked enclosure.

I. Equipment Cabinet Locks: All locks for cabinets or enclosures shall be pin-tumbler or round key locks type. The contractor shall exercise every precaution to protect the security of these keys. Upon completion of the work, the keys, properly tagged, shall be delivered to the Contracting Officer. No more than four (4) keys shall be made or

supplied for each lock. Locks on different units shall be keyed differently.

J. Relays: Light duty relays and similar devices shall have dust covers which protect against fouling by dust or other material which may adversely affect their normal operation.

K. Equipment Housing and Cabinets: Equipment and device housing and cabinets shall be flanged to prevent ready access to the interior of the enclosure until the tamper device has actuated. Holes must be used if knock-out is removed. Enclosures for use in exposed-to-weather, wet or damp locations, shall be weatherproof construction, suitably protected against corrosion. Enclosures shall be designed to protect against fouling by dust or other matter. Cabinets, housing and enclosures with a maximum dimension in excess of 6 inches shall be fabricated of materials providing strength equal to or exceeding 18 US Standard Gage steel. Enclosures with maximum dimension of 6 inches or less shall be fabricated of materials providing strength equal to or exceeding 20 US Standard Gage steel. All cabinets, housing or other enclosures (except those enclosures which are sealed in such manner as to require virtual destruction of the complete unit in order to gain access to the operating elements or to sealed connection within the enclosures) shall be provided with cover-operated corrosion resistant tamper switches arranged to remain inaccessible until activated. Tamper switches shall actuate an alarm signal when the door or cover is moved as much as 1/8" from its normal mounting or position. Tamper switch circuits shall be supervised at all times when the system is in access and secure mode. Tamper switch mountings or fastenings shall not be visible or accessible from the exterior of the enclosure or cabinet. Any openings for ventilation shall be protected by baffles.

L. Local Test: The system shall provide the capability for testing the integrity of all sensing circuits without initiating remote alarms. During the test of a local alarm circuit, sounding of only the local alarms connected to that circuit may be permitted. Sounding or actuating local or remote alarms will be eliminated during the test of all input

circuits. A indicator light or meter shall be provided to permit indication of proper operating condition for each sensing circuit and output circuit. A switching method or programming option shall be provided to permit testing while the system is in the access mode.

2.2 MANUFACTURERS

A. Diebold

B. Potter

C. Approved equal

2.3 ALARM CONTROL PANEL

A. Control Panel: The central control unit shall provide the access/secure function for the system and all equipment necessary for reliable and effective operation of the system. All access doors, movable covers or panels of the control unit shall be locked or secured and equipped with tamper switches. The control unit shall be of the zoned type and provide output signals for activation of local alarms and remote notification equipment. The central control equipment shall be Underwriters' Laboratories listed for burglar alarm use.

B. Control Panel Performance and function: The control unit shall respond to the sensors, tamper switches, and line supervision by actuating the visual signal, the local alarms and remote notification equipment. Central control unit shall be a CPU based programmable unit which promotes the following:

PROGRAMMING
- Programming locally through LCD Keypads or remotely through PC Downloading Software

ZONES
- Be fully programmable EOL supervised hardware zones or circuit board
- Zone programming flexibility including type and reporting characteristics
- Four programmable keypad emergency conditions
- Selectable alarm (16) and trouble (8) types
- Programmable Central Station reporting and restore codes by zone
- Key switch on capability through any zone
- Pulse count option by zone
- Commands to view zone descriptions or IOD keypad

SYSTEM OPTIONS
- Programmable dialer and bell lockout feature
- Accurate real time clock, time programmable by installer

or authorized user.
- Two programmable entry/exit delay times
- Sounder Ring back, and bell test at arming options

MULTIPLEX CAPABILITY
- Convenient two conductor wiring of multiplex loops for easy installation
- Programmable zone characteristics for cache multiplex point

PARTITIONS
- 8 Partitions (sub-panels) per control panel

USER CODES
- Ambush code capability to allow a silent alarm under duress or hold up.

CENTRAL STATION COMMUNICATIONS
- Transmission to two separate CS telephone numbers
- Three or four digit account numbers
- Pulse, touch-tone, or adaptive dialing (tone backed up by pulse)
- Dial tone detection option

POWER SPECIFICATIONS
- 24 hour battery load test and continuous low battery monitoring

KEYPADS
- LED or LCD (may require auxiliary power supply)
- LCD keypad is illuminated with 2-line English language display
- Keypad contain backlit keys

REMOTE COMMANDS
- Remote Downloading and uploading from Alarm Company location
- Remotely arm, bypass, read system status and device control

SYSTEM LOG

Modular Design System

- Panel retains activity log min. 100 units
- System log viewable locally at LCD keypad or from Alarm Company.
- Programmable transfer of system activity to a remote or local printer automatically on either a daily, weekly or monthly basis.

LISTINGS

- UL Commercial Combination Burglary Listings

C. Electric and Stand-by Power Supply Requirements:

(1) Electric Power Supply: The system and components shall be capable of operating on 115 volts AC power with a 10% fluctuation of voltage. The electric power supply shall provide automatic switch over to stand-by power supply during AC power interruption and shall return to normal power when AC is restored. Recharging of stand-by power supply shall automatically begin when AC power is restored.

(2) Stand-by Power Supply: Stand-by power shall be provided by sealed rechargeable batteries capable of recharging to 93% of rated full charge in 24 hours on the AC power normally available and provide a charging regulation to prevent battery over-charge. The power supply shall include an automatic, constant-potential, solid-state, batter charger to maintain batteries at a minimum of 93 percent of rated full load. Stand-by power supply shall provide power for 24 hours of continuous normal equipment operation plus 30 minute continuous alarm operation with all equipment operating. When the system is operating on stand-by power, the equipment shall initiate an alarm when the stand-by power falls below the level required for system to detect intrusion as specified under sensors sensitive requirement. Stand-by power supply may be one supply for all components or each component may contain its own stand-by power supply. Stand-by power shall meet requirements under paragraph 02, J. Stand-by power supply shall be Underwriters' Laboratories approved for burglar alarm use.

D. System Supervision: Line supervision by the central control unit shall provide continuous monitoring of the electrical conditions of the line connecting to the sensor control, sensors, magnetic switches, and local alarm units to maintain the integrity of the transmission portion of the Intrusion Detection System. All line supervision shall be of the fully supervised voltage double loop type and connected to central control unit such that power supply is protected or system shall use a 2 wire encryption circuit.

E. Initiating Circuits: Supervised zone module with alarm and trouble indication.

F. Signal Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode and does not disable that circuit from transmitting alarm.

G. Remote Station Signal Transmitter: Electrically supervised, capable of transmitting alarm and trouble signals over telephone lines to central station receiver.

H. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

I. Occupied/Unoccupied Selector: Keypad

J. Entry and Exit Time Delay: Keypad

K. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:

1. Visual and audible trouble alarm indicated by zone at control panel.
2. Trouble signal transmitted to central station.
3. Manual acknowledge function at control panel silences audible trouble alarm; visual alarm is displayed until initiating failure or circuit trouble is cleared.

L. Alarm Sequence of Operation: Actuation of intrusion detecting device places system in alarm mode, which causes the following operations:

1. Sound and display local alarm signaling devices with non-coded signal.
2. Transmit non-coded signal to remote central station.
3. Indicate alarm on control panel.
4. Alarm Reset: Key-accessible reset function resets alarm system out of alarm if alarm initiating circuits have cleared.
5. Audible Alarm Sequence: Audible device shall sound until silenced.
6. Lamp Test: Manual lamp test function causes alarm indication at each zone at control panel.

2.4 INITIATING DEVICES

A. Detection circuits shall be supervised by End of Line Resistor and shall provide an alarm signal if circuit resistance deviates ± 10%. or provide multiplex 2 unit loop to provide power and data from control panel to sensor.

B. Detection devices shall provide an alarm signal when the electrical continuity of the device is disturbed. Detection devices shall provide for connection to a central control unit. Physical damage to a single sensor or transmission line sufficient to alter the resistance of the circuit more than ± 10% shall create an alarm condition.

C. Magnetic Door and Window Contact Switches: Magnetic switches shall be of a the balanced magnetic type and shall initiate an alarm condition if the strength of the magnetic field is increased or decreased. Magnetic switches shall have "form c" contacts which open and crosses or grounds (single pole, double throw) type. Magnetic switches shall be Underwriters' Laboratories listed for burglar alarm use.

(1) Enclosure: The switch and magnets shall be enclosed in housing of plastic, cast non-ferrous metal or other material providing reasonable protection against water,

tampering, and dust.

(2) Performance: Magnetic switches shall be mounted so that an alarm is initiated wherever the latch or lead edge of the closure on which it is mounted is moved as much as 25 mmfrom its closed position.

D. Audio Detection Equipment: The audio detection equipment shall provide sensitive audio sensors (microphones) mounted in the protected area connected to the amplifier audio control unit. The audio detection equipment shall be Underwriters' Laboratories listed for burglar alarm use.

(1) Audio Sensors: Audio sensors shall be designed to alarm at noise that increases the sound level 30 decibels above ambient or at an overall sound level of 70 decibels. A minimum of two (2) sensors shall be used and sensors shall be mounted such that spacing of sensors will not exceed Underwriters' Laboratories rating of the sensors.

(2) Audio Detection Amplifier Control Unit: The audio amplifier control unit shall be "solid state" construction with relay output which opens and crosses the protective circuit and provides for connection to the central control unit. (unit may be a microprocessor circuit with electric relays)

(3) Audio Equipment Performance: The audio sensors or audio amplifier control unit shall provide for sensitivity adjustment and adjustment control shall be concealed by the cover in which they are located. Audio amplifier control unit shall provide adjustable accumulator circuit which shall count input signals from the sensors with respect to time. The accumulator circuit shall initiate an alarm in response to a series of sensor signals (2 to 5) which occur within an adjustable 1 to 10 minute time range. Audio sensor and audio amplifier shall be capable of initiating an alarm in response to a 50 db noise level above the 1000 Hz frequency (upper range of equipment can vary) within the protected area. Physical damage to a single

sensor or transmission line sufficient to interrupt the continuity of the circuit shall create an alarm condition, regardless of the setting of time or accumulation on the control unit.

E. Passive Infrared Motion Detection: Detectors shall provide volumetric protection for the interior of arms vaults and may be ceiling mounted or wall mounted. Detector shall detect any change in thermal energy patterns caused by a moving intruder. Quad-element sensors shall be used to minimize false alarms. PIR shall be UL listed for burglar alarm use.

2.5 SIGNAL DEVICES

A. Local Alarms: Local alarm unit shall be of the electronic siren (oscillating tone screamer) type capable of being activated from the central control unit. The local alarm unit shall be capable of providing an output of 110 - 135 db oscillating tone, measured at a distance of three feet in front of the unit. Local alarm unit shall be enclosed in a metal (16 gauge) housing and shall have a tamper switch installed so as to be activated when housing is disturbed. In single unit facilities, the interior local alarm shall be located in the unit storage area. In multi-vault facilities (or in facilities in which the vault is not entered through the unit storage area) the interior local alarm shall be located in the drill hall or hallway such that the alarm is audible at all vault door locations. One local alarm unit shall be suitable for exterior installation [weatherproof] and be designed such that speaker cannot be identified. Mounting location of exterior local alarm shall be approved by Contracting Officer. Exterior alarm shall be located in such a way they are not accessible from roof, porches, walkway, ledge, etc.

B. Remote Alarm Notification Equipment: The facility Intrusion Detection System shall be connected to the local law enforcement agency or alarm monitoring company by a supervised, dedicated leased signal grade telephone line equipped with a line security transmitter (complicator) which meets the proposed Underwriters' Laboratories Grade AA

standard UL 611 as it pertains to telephone line security (assuming condition of Grade AA has been met). (Where this condition cannot be met, the term A/E must corridinate with each project’s Officer in Charge for an acceptable method of remote alarm notification signaling.)

1. Line security transmitter shall be of the random digital type with the number of encoded signals to prevent equipment substation as necessary to meet Underwriters' Laboratories requirements. Line security transmitter and /or receiver shall initiate an alarm or trouble signal upon the following:
   - Alarm condition from sensing equipment
   - Stand-by battery failure or below safe operating level
   - Telephone leased line open, short, or cross
   - Attempted compromise

2. Line security receiver shall provide visual and audio signal when activated by an alarm or trouble signal. Line security receiver shall provide for silencing the audible signal, but visual signal shall remain active until the alarm condition has been corrected at the protective area. Line security receiver shall have a name plate to identify the protected premise.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Wiring shall be of the size and type as indicated on the manufacturer's shop drawings.

C. General: Installation of Intrusion Detection System shall be neat, effectively planned and shall provide level of performance required by other sections of the specifications. All wiring within the protected area, wiring to local alarms and telephone wiring to equipment room shall be in EMT

conduit. All other wiring outside the protected area shall be rigid conduit. Pull and junction boxes shall have covers held in place by on-way machine screws which cannot be removed without cutting or drilling. Except as specifically indicated above, all electric work and transmission lines for the system shall comply with the applicable provisions of Section 16, Electric Work, of these specifications.

D. Repair of Existing Work: The work shall be carefully laid out in advance. Where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or paving, or other surfaces is necessary for proper installation, the work shall be accomplished by skilled mechanics of the trades involved. Any damages to the building, paving, piping or equipment shall be repaired and refinished by skilled mechanics of the trades involved at no additional cost.

E. Coordination: All coordination with the local law enforcement agency and telephone company shall be the responsibility of the contractor. In location where law enforcement agency owns or contracts for an alarm monitoring console, contractor shall pay installation charge to connect the National Guard alarm system. Telephone installation and monthly lease charges shall be billed as directed by owner.

F. Within the vault, THERE WILL BE NO WIRE SPLICES. Outside the protected area, splices will be permitted in junction boxes. Splices for control and signaling circuits shall be soldered with 60/40 Eutetic tin/lead resin core solder and the joint taped with the proper thickness of rubber or vinyl plastic tape. Splices in power conductors (120 VAC) shall comply with Section 16123 of this specification.

G. No wire or cable shall be installed until the raceway system is completed and has been checked for freedom of obstruction and swabbed or vacuumed.

H. Grounding shall be in accordance with Art. 250 of the NEC and Section 16170.

I. Conduit inside the arms rooms shall be exposed and painted.

J. Raceways outside the arms rooms shall be installed concealed in walls and above ceilings, except in equipment rooms and utility rooms, or as otherwise indicated on the drawings.

K. Provide a bushings with an insulated throat on the ends of all conduits where they terminate in outlet or junction boxes, equipment cabinets, etc.

L. Outlet, pull and backboxes shall be supported as specified in Section 16130 unless otherwise specified.

M. Control panel shall be secured to walls with a minimum of four bolts. Where supported on concrete masonry or block walls, anchors or other devices designed for this purpose shall be used. Where supported on gypboard and stud walls, vertical and horizontal bracing in the wall shall be provided to support the weight of the panel and its contents and to receive the bolts or screws. Refer to Section 16190 and 16191.

N. Mounting Balanced Magnetic Switches on Doors: Balanced Magnetic Switches (BMS) are two (2) part assemblies; the actuating magnet and the switch assembly. There is an index mark in one (1) side of each half of the Actuating Magnet Assembly. The halves should always be assembled so that the index marks are in the same "one" corner. The Contractor shall furnish any necessary mounting brackets and/or hardware. The BMS Magnetic Switch Assembly and the Actuating Magnet Assembly must be mounted in the same plane. Components are to be mounted so they are separated by a distance greater than 6 mm and less than 25 mm when the door is closed.

O. All wire shall be tagged at all junction points and pull boxes and shall test free of grounds or crosses between conductors.

P. Final connections between equipment and system wiring shall be made under the direct supervision of a representative of the manufacturer.

Modular Design System

Q. The covers of all pull boxes and junction boxes in the conduit system for the security system shall be painted blue to identify them.(Delete if not required by Security Officer)

R. Provide a laminated plastic sign attached to the front outside the control panel and annunciator with a minimum of two screws which reads "Vault Security System". The sign shall be black with 6 mm high white characters. Provide a separate sign of the same specification on the control panel that indicates the power circuit number for the control panel.

3.2 FIELD TESTS

A. Acceptance Tests: The contractor shall conduct test to determine system conformance to requirements of this specification. Tests shall be conducted in the presence of the Contracting Officer or his authorized representative who may suspend or discontinue the test at any time performance is considered unsatisfactory. Upon resumption of testing all equipment shall be retested. The contractor shall furnish all test personnel except for those required to maintain records for the Contracting Officer. Standard inventory type test instruments and equipment necessary to perform adequate testing of the IDS equipment installation shall be furnished by the contractor.

3.3 MANUFACTURER'S FIELD SERVICES

A. Include services of technician to supervise installation, adjustments, final connections, system testing, and Owner training.

B. Guarantee: The Intrusion Detection System installed under this specification shall be guaranteed for a period of one year from the date of acceptance against defective materials, design, and workmanship. Upon receipt of notice form the State of failure of any part of the guaranteed system during the guarantee period, new replacement parts shall be furnished and installed by technically qualified personnel employed by the contractor at no additional cost to the State. During the guarantee period, the contractor shall provide for quarterly service and maintenance calls by technically qualified personnel without additional charge. Not more than one such call shall be an emergency call, which shall be answered by technically qualified personnel within four hours. Additional emergency or service calls shall be at the contractor's regular rates for such calls, unless such call shall be the result of failure of a part of the guaranteed system during the guarantee period. During each such call, the complete system and all elements will be tested and/or examined to assure proper functioning. Adjustments and/or replacements will be made to assure continuing satisfactory performance of the system. All such tests, adjustments or replacements shall be made in the presence of a designated representative of the Contracting Officer. Upon completion of each call a report will be provided to clearly indicate any replacements or adjustments or any evidence of tampering. Contractor and Equipment Manufacturers shall guarantee and electromagnetic Radio Frequency Interference (RFI) compatibility equipment found to be susceptible to RFI shall be modified or replaced for a period of one year without cost to the State. Each replacement/repair of equipment or component shall be guaranteed for one year from the time of the installation of the repaired or replace item.

C. Documentation and Training: The installation of the Intrusion Detection System shall include the furnishing of documentation providing technical information of the system as installed and training of operating personnel.

a. Training of Operating Personnel: The training shall include instruction on the operation of control unit, equipment on the operation of the control unit, equipment in the secured areas, and procedures to be followed in requesting emergency service. Training shall be presented by a qualified instructor using such drawing, charts, training aids, and demonstrations with such components as are deemed necessary by the Contracting Officer. Training shall provide at least one hour of instruction on each system installed and shall orient responsible personnel to a level satisfactory to the Contracting Officer.

END OF SECTION

SECTION 16741

TELEPHONE SYSTEM, INSIDE PLANT
AVIATION SUPPORT FACILITY
FORT EUSTIS, VA

1. GENERAL.

1.1 REFERENCES:

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Technical documents that form a part of the documents below are also applicable as project guidelines.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/IEEE C2 (1996) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

ASTM C388-73 (1973) Softening Point of Glass

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
TELECOMMUNICATIONS INDUSTRIES ASSOCIATION (TIA)

TIA/EIA-568-A (1995) Commercial Building Telecommunications Cabling Standard (ANSI/TIA/EIA-568-A-95)

TIA/EIA-568-A/TSB-67 (Nov 95) Technical Systems Bulletin, Link Performance Transmission Specification for Field Testing of Unshielded Twisted Pair Cable Systems

EIA/TIA-569 (1990) Commercial Building Standard for Telecommunications Pathways and Spaces (ANSI/EIA/TIA-569-90)

TIA/EIA-606 (1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings (ANSI/TIA/EIA-606-93)

TIA/EIA-607 (1994) Commercial Building Grounding and Bonding Requirements for Telecommunications (ANSI/TIA/EIA-607-94)

EIA/TIA-455-A (1991) Standard Test Procedures for Fiber-Optic Fibers (ANSI/EIA/TIA-455-A-91)

EIA/TIA 455-47B (1992) FOTP-47 Output Far Field Radiation Pattern Measurement (ANSI/EIA/TIA-455-47B-92)

BELLCORE

BELLCORE TR-TSY-000268 (Issue 3; May 89; Supple; 1 June 90) ISDN Access Call Control Switching and Signaling Requirements

DEFENSE INFORMATION SYSTEMS AGENCY (DISA)

DISA DCAC 370-175-13 (5 April 88) DSN System Interface Criteria

CODE OF FEDERAL REGULATIONS (CFR)

CFR 47 Part 68 Connection of Terminal Equipment to Telephone Network

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1993) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL Publication (1995) UL’s LAN Cable Certification Program

UL Publication (Jan 1996) Verified LAN Cable Products Directory

Pub. Ref. No. 1 (Apr 91) Electrical Construction Materials List

UL 94 (1991; Rev Aug 1992)
Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 GENERAL DESCRIPTION:

A premises distribution system consisting of entrance facilities (telecommunications closets), backbone and horizontal pathways, inside plant cables, and other auxiliary equipment comprising a complete system for voice, and data shall be provided as indicated on drawings.

1.2.1 OPERATING CONDITIONS:

The electronic equipment designed for office environments shall be rated for continuous operation under ambient environment conditions of 50 degrees F to 85 degrees F and 35 to 65 percent relative humidity, noncondensing.

1.3 GENERAL REQUIREMENTS.

1.3.1 All equipment and all work under this section shall be furnished and installed by a certified telecommunications contractor, hereafter referred to as the Contractor. Paragraph 1.4, Contractor Qualifications, further defines this requirement.

1.3.2 Minimal Requirements:

All specifications are minimal requirements.

1.3.3 UL Listing:

1.3.3.1 Materials and equipment requiring UL 94 listing shall so be labeled.

1.3.3.2 Modification of products which nullifies UL label is not permitted.

1.4 CONTRACTOR QUALIFICATIONS.

1.4.1 Verification:

The Contractor shall submit verification of the qualifications specified below with the shop drawings submittals. The Contractor shall have the following minimum qualifications in Telecommunications Systems.

1.4.1.1 The Contractor shall have a minimum of five years experience in the design, application, installation and testing of the specified systems and equipment.

Modular Design System

1.4.1.2 The Contractor shall employ industry trained personnel to perform systems engineering and design. All system designers and engineers shall have a minimum of three years experience on the specified system and all recommended components.

1.4.1.3 All supervisors and installers assigned to the installation of this system or any of its components shall have industry training for each area of installation. The supervisors and installers shall also have factory certification on all components used in the installation. General electrical trade staff (electricians) shall not be used for the installation of the fiber optic and unshielded twisted pair (UTP) cables and associated hardware.

1.4.1.4 All installers assigned to the installation of this system or any of its components shall have a minimum of one year experience in the installation of the specified fiber optic and Category 5 UTP cable and associated hardware. Installation supervisors shall have a minimum of three years experience in the installation of the specified fiber optic and Category 5 UTP cable and associated hardware.

1.4.2 Minimum Manufacturer Qualifications:

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of three years experience in producing the types of systems and equipment specified.

1.5 SUBMITTALS

Submit under provisions of Section 01300. Refer to Section 16010.

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

Data

Manufacturer’s Catalog Data

Data composed of manufacturer’s catalog cuts, brochures, circulars, specifications and product data, and other information in sufficient detail and scope to verify compliance with requirements of the contract documents. This shall include a description of the system operating characteristics and individual data sheets for each item of equipment indicating descriptive and technical data, operating temperature limits, and mounting restrictions. If a data sheet covers several types or sizes of equipment, the sheet shall be marked to indicate the specific item provided.

Modular Design System

Spare Parts Data

These are data lists of tools and test equipment for each different item of material and equipment specified, after approval of detail drawings not later than one month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Drawings

Detail Drawings

Detail drawings include complete riser diagrams, wiring and schematic diagrams, run sheets including number of conductors and wire number (ID), custom assembly details, installation details, and any other details required to demonstrate that the system complies with specifications, has been coordinated and shall properly function as a unit. Installation drawings shall be to scale with critical dimensions shown.

Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearance for maintenance and operations, and plan and elevation details.

Coordination Drawings

Coordination drawings shall show all electronic and physical interface details.

As-Built Drawings

As-built drawings shall show final systems configuration, including location, type, gauge, and block and terminal assignment of inside wiring, and floor plan layout for the equipment, after installation.

Instructions

Manufacturers' Recommendations

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations will be received and approved by the Government, prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Modular Design System

Statements

Test Plan

This deliverable is a test plan defining all tests required to ensure that the system meets technical, and operational and performance specifications, delivered 60 days prior to proposed test date. The test plans and test procedures shall explain in detail, step-by-step, actions and the expected results to demonstrate compliance with the requirements of this specification.

Test plans shall include a list of all test equipment to be used, test data sheets, and names and qualifications of the person(s) that will be performing the tests.

Reports

Test Reports

These are test reports, in booklet form, showing all field tests performed to adjust each component, and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

Qualifications

The qualifications of the Manufacturer(s), Contractor(s), and the Installer(s) to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

Certificates

Premises Distribution System

Written certification that the premise distribution system fully complies with the TIA/EIA-568-A, EIA/TIA 569, TIA/EIA 606, and TSB 67 standards.

Station Cables

Plates and Jacks

Installers

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

Modular Design System

Operations and Maintenance Manuals

Manufacturer's Manuals

Commercial off the shelf manuals for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment.

1.6 SYSTEM DESCRIPTION:

The telephone system, inside plant (ISP), shall provide the specified cabling, connection points, and jacks to support (GFGI or Contractor installed) voice, data, and station terminal apparatus. The ISP shall be constructed with Category 5 UTP horizontal cabling to termination jacks, as indicated on drawings

1.7 DELIVERY AND STORAGE:

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

2. **PRODUCTS.**

2.1 STANDARD PRODUCTS:

All materials and equipment as provided shall be standard Commercial-Off-The-Shelf (COTS) products of a manufacturer(s) regularly engaged in the manufacture of the products. All products shall be the manufacturer's latest standard design that is typical commercial design, and that complies with the requirements specified. All material and equipment shall be readily available through the manufacturers and/or distributors.

2.1.1 Modifications:

Modification of products which nullifies UL label or other agency approval is not permitted. Modification of product(s) at the module level, component level, or in the software which would result in a non-standard product offering as described in paragraph 2.1 above is not permitted.

2.1.2 Condition:

All products shall be new and free of defects or material abnormalities.

Modular Design System

2.1.3 Identical Items:

Items of the same functional classification shall be identical. This requirement includes equipment, modules, assemblies, connectors, parts, firmware, and components for the entire system.

2.2 NAMEPLATES:

Each major component of equipment shall have the manufacturer's name, model number, and serial number on a plate secured to the equipment.

2.3 INSIDE CABLING.

2.3.1 Horizontal Cables.

2.3.1.1 Copper Cable:

All unshielded twisted-pair (UTP) horizontal cable between the telecommunication outlet and modular RJ-45 patch panel shall conform to TIA/EIA-568-A, configured for the eight position jack pin/pair assignments, designation T568A. Unless otherwise specified, all UTP cabling shall be Category 5, solid copper conductor, 4-pair, 24 AWG, and shall comply with TIA/EIA-568-A for Category 5 cable. Only UTP cable that has passed and been accepted by the UL LAN Cable Certification Program shall be used. The cable surface shall be marked with the acceptable UL cable markings "Verified (UL) Category 5", "Classified (UL) Category 5", where "CAT" may be substituted for "Category". Where required, cable shall be classified low smoke and low flame for use in air plenums in accordance with NFPA 70.

2.3.2 Plates and Jacks.

2.3.2.1 Telecommunications Outlets:

All in-wall outlet boxes shall be standard UL approved, steel AC power type double gang boxes. In-wall boxes shall be attached to the structure without the use of the cover or its attachment points. Wall plates shall come equipped with two modular four pair RJ-45 jacks, with one jack labeled "voice" and the other jack labeled "data" and two ST connectors. The modular jacks shall be configured for the eight position jack pin/pair assignments, designation T568A and shall conform to TIA/EIA-568-A for Category 5, NFPA 70 and CFR 47 Part 68. Mounting plates provided for systems furniture shall match the systems furniture in color.

2.3.2.2 Wall and Pay Telephone Outlets:

All wall and pay telephone outlet boxes shall be standard UL approved steel AC power type single gang boxes, capable of directly mounting a "lug-type" outlet cover. Wall boxes shall be attached to the structure without the use of the cover or its attachment points. Wall plates shall come equipped with a single modular RJ-45 type jack. Jacks shall conform to CFR 47 Part 68 and NFPA-70 and TIA/EIA-568-A for Category 5 connecting termination hardware and the eight position jack pin/pair assignments, designation T568A.

2.3.3 Telephone Backboard:

Telephone backboard shall be constructed of ¾ inch ACX plywood and be coated on both sides with two coats of fire retarding, insulating varnish, as a minimum.

2.3.4 Cable Management:

Telephone backboards shall be provided with standard cable management rings and wire-ways to support the cabling, as shown on project drawings. Cable management shall be used for both the vertical and horizontal cabling on the backboard. The quantity of cable management rings and wire-ways shall be based upon the cable size and number of 110 type blocks. Cable management rings and wire-ways fill shall not exceed 60 percent.

2.3.5 Terminal Blocks:

Terminal blocks shall be 110D-type, wall mounted wire termination units consisting of insulation displacement, gas tight connector blocks, wired for TIA/EIA-568-A, configuration T568A. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall be plated, shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals. Connecting termination hardware shall conform to TIA/EIA-568-A for Category 5.

2.3.6 Patch Panels.

2.3.6.1 Voice Patch Panels:

UTP patch panels for voice cable shall be 48 port minimum, 4 pair RJ-45 to Amphenol (50-pin) connector patch panels, 19" rack mountable. Connecting termination hardware shall conform to TIA/EIA-568-A for Category 3. The RJ-45 connectors shall be configured as the eight position jack pin/pair assignments, designation T568A. The number of RJ-45 connectors shall be based on the riser cable counts shown on project drawings (one RJ-45 appearance per four-pair riser cable).

Modular Design System

2.3.6.2 Horizontal Patch Panels.

2.3.6.2.1 UTP Patch Panel:

UTP patch panels shall be 48 port minimum, 4 pair RJ-45 to 110-Type Modular Patch panels, 19 inch rack mountable. Connecting termination hardware shall conform to TIA/EIA-568-A for Category 5. The RJ-45 connectors shall be configured as the eight position jack pin/pair assignments, designation T568A. The number of RJ-45 connectors shall be based on the number of user outlets or Category 5 cable counts shown on project drawings.

2.3.6.2.2 Singlemode Patch Panel:

The patch-panel for the singlemode fiber entering the building shall be rack mountable fiber enclosures with 8.3/125 micron singlemode, SC-type feed-through couplers. The fiber enclosures shall come equipped with routing rings and tie down clamps for the fiber optic cable. Incoming fiber-optic cables shall be terminated at the rear of the patch panel. Fiber-optic patch cables for cross-connections shall be terminated on the front of the fiber patch panel. The number of SC couplers shall be based on the number of fiber optic cable counts shown on project drawings.

2.3.6.3 UTP Patch Cables:

Patch cables both within the telecommunications closet and at the telecommunications outlet shall be unshielded twisted-pair (UTP) cable and shall conform to TIA/EIA-568-A, configured as the eight position jack pin/pair assignments, designation T568A. Unless otherwise specified, all UTP patch cabling shall be Category 5, 4-pair, 100 ohms ± 15 ohms UTP, and shall comply with TIA/EIA-568-A section for Category 5 patch cables. Only UTP cable that has passed and been accepted by the UL LAN Cable Certification Program shall be used. The cable surface shall be marked with the acceptable UL cable markings "Verified (UL) Category 5", "Classified (UL) Category 5", where "CAT" may be substituted for "Category".

2.3.7 Telecommunications System Labeling:

The telecommunications systems labeling shall be done in accordance with ANSI/TIA/EIA 606. The Contractor shall label all outlets as to their function and with a unique identifier code. All devices, outlet locations, and designations shall also appear on the system drawings.

2.3.7.1 Telecommunications Patch Panel Labeling:

Patch panel labeling shall be done in accordance with TIA/EIA 606. Each outlet location shall be labeled with a unique designator. The top or left RJ-45 type, Category 5 compliant port for each outlet location shall be designated for voice and be labeled "VOICE". The bottom or right RJ-45 type, Category 5 compliant port for each outlet location shall be designated for data and be labeled "DATA". Fiber-optic port labeling shall be done in accordance with EIA/TIA 606. The left or top SC port shall be labeled "A" and the right or bottom SC port shall be labeled "B".

2.3.7.2 Telecommunications Jack Labeling:

Jack labeling shall be done in accordance with ANSI/TIA/EIA 606 and the Standard Diagram. . Each outlet location shall be labeled with a unique designator. The top or left RJ-45 type, Category 5 compliant jack shall be designated for voice and be labeled "VOICE". The bottom or right RJ-45 type, Category 5 compliant jack shall be designated for data and be labeled "DATA". All LAN components in the system shall also be labeled with similar designations in accordance with EIA/TIA 606.

2.4 EQUIPMENT RACKS:

Floor mounted equipment racks shall be welded steel relay racks with uprights to mount equipment 19 inches wide. Uprights shall be three inch deep channel, 1-1/4 inches wide, drilled and tapped 12-24 in a 1/2 inch pattern. Racks shall be provided with a standard top cross member, and pre-drilled base plate to allow floor fastening. Open frame equipment racks shall be seven feet in height and painted with gray finish. Each rack shall be provided with a quad 110 volt AC outlet, mounted in the bottom of the rack, as shown on project drawings.

2.4.1 Cable Management:

Equipment racks shall be provided with standard cable management rings and panels to support the cabling, as shown on project drawings. Cable management shall be used for both the vertical and horizontal cabling within the rack. The quantity of cable management panels shall be based upon the number and sizes of the UTP and fiber optic patch panels. Cable management rings and panels fill shall not exceed 40 percent.

2.5 TELECOMMUNICATIONS PREMISE CABLE PATHWAYS.

All telecommunications premise cable pathways and infrastructure must conform to EIA/TIA-569.

2.5.1 Rigid conduit shall be zinc plated four inch diameter Electrical Metallic Tubing (EMT) and shall comply with the following guidelines:

2.5.1.1 No single section of conduit shall be longer than 30.48 m or contain more than two 90 degree bends between junction boxes or pull points.

2.5.1.2 All couplers between conduit lengths and connectors to junction boxes and pull points shall be compression type fittings.

2.5.1.3 The inside radius of a bend in conduit shall be at least six times the internal diameter. When the conduit size is greater than two inch, the inside radius shall be at least 10 times the internal diameter of the conduit. For fiber optic cable, the inside radius of a bend shall be at least 10 times the internal diameter of the conduit.

2.5.1.4 Pullcord shall be placed in installed conduit.

2.5.1.5 Conduit runs extending from a telecommunications closet, cable tray or cable raceway shall be a minimum of 27 mm rigid EMT.

2.5.1.6 Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.

2.5.2 Flexible Conduit:

Conduit used to connect to raised floor outlets shall be flexible ferrous metallic of a minimum of one inch inside diameter with a non-ferrous, non-conductive outer coating. Where required, flex conduit insulation shall be classified low smoke and low flame for use in air plenums in accordance with NFPA 70. Fish tape or pullcord shall be placed in installed flexible conduit.

3. EXECUTION.

3.1 INSTALLATION:

System components shall be installed as specified or as shown. Necessary interconnections required for a complete and operable telephone circuit shall be provided. Installation work shall be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.

3.1.1 Industry Standards:

All work shall be installed as indicated and specified, and in accordance with acknowledged industry, technical, and professional standards and practices, and manufacturers recommendations. Specifically, installation shall conform to the guidelines as specified in TIA/EIA-568-A, EIA/TIA-569, and NFPA 70.

3.1.2 Tools and Test Equipment:

The Contractor shall provide all tools and test equipment needed to install and test the system.

3.1.3 Miscellaneous Hardware:

The Contractor shall provide all miscellaneous hardware and accessories as required for a proper installation.

3.2 INTERIOR WIRING.

3.2.1 Cable Laying.

3.2.1.1 Interior wiring shall be installed in raceways, cable trays, and boxes as specified and terminated at station locations indicated.

3.2.1.2 All cables between the same points shall be run over the same path.

3.2.1.3 All cables and wiring shall be installed and terminated at all station locations as indicated on project drawings. Wiring shall take the form of a "Universal Wiring Plan" where horizontal cables are wired directly, home run fashion, from a distribution point to the appropriate modular jack plate, jack assembly, or floor jack to support the use of single line type sets and electronic sets. Each individual cable run shall be continuous and uninterrupted and shall have no bridge taps, branches, splices or "Y" connections at any point.

3.2.1.4 Cables shall be installed in accordance with applicable fire codes, the manufacturer’s recommendations and the requirements listed below.

3.2.1.5 There shall be no kinks, sharp bends or deformation in the installed cable. Any bends in the cable shall meet the recommendations of the cable manufacturer.

3.2.1.6 There shall be attachments, fastenings, and supports in conformance with the cable manufacturer’s recommendations for the type and size cable as installed and consistent with the installed environment.

3.2.1.7 All vertical cable runs in duct or on ladder shall be tied with plastic straps or lacing twine at the top of the run and at least every three vertical feet to prevent cable strain. Horizontal wiring shall not be bundled in groups larger that 16 cables.

3.2.1.8 A proper cable lubricant, approved by the Contracting Officer, shall be applied at the manufacturer’s recommended rate during the installation of the cable assemblies into conduits. No cable lubricant is to

be utilized on cable assemblies installed in cable trays.

3.2.1.9 The cable shall be installed in a manner so as to prevent crushing, stretching, abrasion, puncture, and other mechanical damage.

3.2.1.10 All cables and cross connects shall be neatly strapped, dressed and adequately supported. Provide cable clamps, strain relief devices, and ties as required to maintain the workmanlike appearance of the installation and as recommended by the manufacturer. Where required, strain relief devices and ties shall be classified low smoke and low flame for use in air plenums in accordance with NFPA 70.

3.2.1.11 In no case shall any cable be attached to any conduit, pipe, associated supporting clamp or bracket, or false (suspended) ceiling system.

3.2.1.12 No less than one foot of slack material shall be left in each horizontal cable at each outlet and no less than three feet at the telecommunications closet to facilitate maintenance.

3.2.1.13 Cables shall be installed in the conduits, cable trays, cable ladders and wireways provided and as indicated on the drawings. Cable shall not be installed outside of these wireways, including but not limited to freely suspended without support, on decks or walking surfaces, on suspended ceiling grid work, or on the work of other trades which are not specifically designated as wireways.

3.2.1.14 Horizontal cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with AC power cables.

3.2.1.15 Within the telecommunications closets the cable shall be supported at all times by cable trays and cable ladders and down to the telecommunications/equipment racks or backboard as indicated on the drawings. Within the telecommunications rack or on the backboard, cable shall be supported by cable management rings and panels as indicated on the drawings. Cable shall not be placed within the "U" frame of the rack, unless the rack is specifically designed to manage cable in such a way.

3.2.1.16 Cables shall be installed loosely within horizontal cable trays and conduits. Cables shall not be taped laced or strapped to each other or bundled in groups larger than 16 cables.

3.2.1.17 Cable shall enter and leave the cable trays in a manner which conforms to the manufacturer’s recommendations and the drawings.

3.2.1.18 Backbone and horizontal cable shall be properly terminated and tagged at both ends to provide permanent station identification.

Modular Design System

3.2.2 Labeling:

All cables shall be labeled in accordance with ANSI/TIA/EIA 606 within six inches of the connection with wrap-around adhesive write-on strips that seal the writing behind clear tape. The Contractor shall label all cables at each end with a unique identifier. All cables shall be labeled at each connection with their functions, local connection point, and remote connection point. Labels shall be permanent and readable from one foot. Labels shall not be removable by normal cable movement nor shall they be easily removed by hand.

3.2.3

3.2.4 Cable Pathways:

The Contractor shall furnish and install new cable tray or duct in the false ceiling, and cable ladder in the telecommunications closets as shown on the project drawings. The cable pathways shall be used to install the premises distribution system cabling based on the construction of the area.

3.2.4.1 Location:

Cable trays and duct shall be located over corridors, hallways, and other public areas, whenever possible, to avoid subscriber disruption during maintenance when the building is occupied. Private or secure areas shall be avoided. Cable pathways shall not be located near pipes, radiators, windows, doors, or any other equipment which may cause damage to the cable by exposure or detrimental conditions. Cable trays shall be located so as not to interfere with future expansion. The Contractor shall install the cable tray horizontally or vertically around, over or under the HVAC ducts to maintain the cable tray capacity as shown on the drawings.

3.2.4.2 Support:

The cable tray, shall be supported using the manufactures recommended support brackets, threaded rods and associated hardware. The cross strap shall not be used to support the overhead cable tray. Vertical structures such as cabinets, relay racks, frames and bays, attached to the floor for panel- mounted equipment, may be used for supporting associated cable ladder runs. The installation of all cable trays, ducts, and ladders shall conform to industry standards.

3.2.4.3 Grounding:

The cable pathway system shall be grounded to the AC power or building structure (one or the other per building, a combination within a building is not allowed) ground at intervals not to exceed 22.85 m. This grounding may be accomplished through the mounting hardware or by separate wire (minimum 12 AWG).

3.2.4.4 Wall Transitions:

The Contractor shall seal holes in walls around signal ducts and conduits equivalent to that of the wall. Duct covers shall be spliced on each side of the wall (with joint shields) to allow a non-removable section of cover within the wall. Any reductions required at fire walls shall provide multiple runs through the wall totaling at least as many square inches of area as the duct or conduit running to the wall.

3.2.4.5 Fire Stopping:

It shall be the responsibility of the Contractor to perform any and all sealing, filling, or fire stopping through bulkhead fittings with materials and practices in compliance with applicable codes, regulations and directives.

3.3 OUTLETS.

3.3.1 Outlet Placement:

Outlets shall be installed in the approximate positions indicated on the drawings. All telecommunications outlets shall be mounted 460 mm above the finished floor (AFF). All wall telephone outlets shall be mounted 1220 mm above the finished floor for standard telephones, and 864 mm AFF for handicap access telephones.

3.3.2 Wall Outlets:

Outlets shall be flush mounted on the wall. The outlets shall be steel duplex AC power type boxes fastened in the wall, without assistance from the cover. Steel conduit (a minimum of 27 mm) shall extend from the distribution system directly to the outlet.

3.4 RACKS.

3.4.1 Rack Placement:

Racks shall be bolted to the true floor at all corners with minimum 10 mm hardware and to any adjacent racks. Racks must be positioned to allow three feet of clearance in front and behind the racks. Racks must be placed to allow complete opening of other fixed area enclosure doors or covers.

3.4.2 Rack Configuration:

The Contractor shall wire AC power from a separate 20 amp circuit breaker to each rack, running the circuit in conduit (under the false floor where such exists). The Contractor shall install both vertical and horizontal cable management rings and panels in the racks as indicated on the drawings.

3.4.3 Copper Patch Panels:

Category 5 copper patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus ten percent (10%) spares. Cable guides shall be provided above, below and between each panel.

3.5 BACKBOARDS.

3.5.1 Backboard Placement:

The Contractor shall provide and install telephone backboards as shown on drawings. The backboards shall be mounted to the wall at all corners with minimum 10 mm hardware, and shall be constructed of 19 mm ACX plywood with a minimum of two coatings on both sides of insulating varnish.

3.5.2 Backboard Configuration:

The Contractor shall wire AC power from a separate 20 amp circuit breaker to each backboard, running the circuit in conduit (under the false floor where such exists). The Contractor shall install both vertical and horizontal cable management rings and panels on the backboard as indicated on the drawings.

3.5.3 Terminal Blocks:

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

3.6 CONNECTORS.

3.6.1 All connectors in this system shall be assembled with full compliance to the assembly standards of the manufacturer of the connector.

3.6.2 All connectors shall be assembled with tooling, dies, adhesives, and procedures recommended and approved by the connector manufacturer.

3.7 GROUNDING.

3.7.1 General:

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable splices and terminals shall be grounded. The Contractor shall provide and install a Signal distribution system ground in the telecommunications entrance facility (Master Ground Bus - MGB) and in each telecommunications closet in accordance with TIA/EIA 607. Grounds may be run from building signal ground points with minimum 6 AWG wire through the appropriate signal distribution system. All outside plant cable shields shall be bonded to this ground using minimum 12 AWG wire. The resistance from cable to ground bus can be no greater than .01 Ohms. Ground wires shall be connected with screw-down connectors to the bus. An earth ground shall be established of ten ohms or less total resistance from the MGB to, and including the ground. Equipment racks shall be connected to the electrical safety ground.

3.7.2 Execution:

The Contractor shall ground all cable shields to signal ground at one end only using the facility single point ground system. Looping of shield grounds through connectors is acceptable as long as it does not result in more than one ground attachment for cables using the single point ground policy. There shall be no interconnections between AC power hazard ground and signal ground except where the two grounds cannot be separated within equipment. Cable shields may be connected to the equipment hazard ground only where there is no way to pass the signal ground through the connectors or equipment to the cable.

3.8 INSTALLATION INSPECTIONS:

Quality Assurance shall be provided through the performance of pre-installation, in-progress, and final inspections.

3.8.1 Pre-installation Inspection:

The Contractor shall make an inspection of all equipment and materials to be utilized in this project. All items shall be verified for compliance with the requirements of this document, the installation, and other referenced standards. This inspection shall also include determination of site preparation, availability of installation materials, status of Government-furnished equipment (GFE), Contractor-furnished equipment (CFE), local purchase request (LPR) items, as well as leased equipment and transmission facilities (as applicable). The Contracting Officer or representative will participate in and witness the pre-installation inspection.

3.8.2 In-Progress Inspections:

The Contractor shall perform in progress inspections which shall include visual inspections of equipment condition, wiring, splicing, fiber-optic cabling, mounting and placement of equipment, miscellaneous hardware and adherence to safety procedures. The Contracting Officer or representative will also perform in-progress inspections as required and verify that the Contractor in-progress inspections are performed in order to assure compliance with the specified installation criteria.

3.8.3 Final Inspection:

The Contractor shall conduct a final inspection that encompasses all phases of the installed project. This inspection shall be conducted to verify that all phases of the contract have been completed according to the contract requirements and proper installation practices have been followed. This inspection shall include a review of "red-lined" drawings, if applicable. The Contracting Officer or representative will participate in and witness the final inspection.

3.8.4 Corrective Action and Verification Inspection:

The Contractor shall correct any areas of noncompliance with requirements that are revealed by inspections. Following correction, a re-examination of previous noncompliance areas will be conducted at the discretion of the Contracting Officer or representative.

3.9 TESTING.

Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test. The tests shall be witnessed by Government Quality Assurance Personnel or the Contracting Officer's on site representative. Any discrepancies noted during testing shall be corrected, and those tests rerun, within 14 days. Contractual acceptance testing shall begin no later than two weeks prior to cutover.

3.9.1 Test Plan:

The test plan shall define milestones for each test, equipment, personnel, facilities, and supplies required. The test plan shall include the detailed test procedures to be completed, cross referenced to the specific contractual requirement. The plan shall also include steps for verification of station records and cable locations for all stations.

Modular Design System

3.9.2 Test Reports:

A report detailing the results of all testing shall be delivered to the Government within seven days after completion of each phase of testing. The report shall contain sign-off/completion sheets for each test indicating test results, reason for failure, and signature blocks for both the Contractor and Government witness. Test sheets shall have the minimum:

a. Name of person(s) conducting the test
b. Name of person(s) witnessing the test
c. Type of test being performed
d. Name, model and serial number of the test equipment
e. Calibration date of the test equipment

3.9.3 Test Equipment:

The Contractor shall supply and maintain the necessary test equipment to accomplish the following tests. All test equipment shall meet or exceed the standards, specifications and parameters as stated in the document. The Contractor shall maintain current calibration of all test equipment during the entire testing period. Calibration shall be accomplished according to the manufacturers specifications.

3.9.4 Tests.

3.9.4.1 Basic Connection Tests:

Basic connection tests shall verify that the outlets are identified and connected in accordance with the drawings and specifications.

3.9.4.2 Unshielded Twisted Pair (UTP) Tests:

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the telecommunications closet and at the outlet. Horizontal wiring shall be tested from and including the termination patch in the telecommunications closet to and including the modular jack in each room. Backbone (riser) cabling shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective telecommunications closets. These tests shall be completed and all errors corrected before any other tests are started.

Modular Design System

3.9.4.3 Category 5 Cable Tests:

The Contractor shall test all Category 5 cable runs in accordance with TIA/EIA TSB-67. Testing shall be done using the TSB-67 Basic Link test and channel tests procedures for Level II testing. Test equipment used shall meet the Level II accuracy requirements of TSB-67. The tests shall be accomplished between each outlet drop and the associated telecommunications closet.

SECTION 16742

TELEPHONE SYSTEM, OUTSIDE PLANT
AVAITION SUPPORT FACILITY
FORT EUSTIS, VA

PART 1. GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Technical documents that form a part of the documents below are also applicable as project guidelines.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1993) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 228	(1991) Steel Wire, Music Spring Quality
ASTM C 338	(1973; R 1988) Softening Point of Glass
ASTM D 2239	(1989) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

EIA/TIA 455-25A	(1989) FOTP-25 Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies
EIA/TIA 455-30	(1991) FOTP-30 Frequency Domain Measurement Optical Fiber Information Transmission Capacity
EIA/TIA 455-33	FOTP-33 Fiber Optic Cable Tensile Loading and Bending Test
EIA/TIA 455-41	(1985) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables

EIA/TIA 455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
EIA/TIA 455-47A	(1992) FOTP-47 Output Far Field Radiation Pattern Measurement
EIA/TIA 455-51A	(1991) FOTP-51 Pulse Distortion Measurement of Multimode Glass Optical Fiber Information Transmission Capacity
EIA/TIA 455-53A	(1990) FOTP-53 Attenuation by Substitution Measurement for Multimode Graded-Index Optical Fibers or Fiber Assemblies Used in Long Length Communications Systems
EIA/TIA 455-54A	(1990) FOTP-54 Mode Scrambler Requirements for Overfilled Launching Conditions to Multimode Fibers
EIA/TIA 455-65	(1988) FOTP-65 Optical Fiber Flexure Test
EIA/TIA 455-81A	(1992) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA/TIA 455-82	FOTP-82 Fluid Penetration Test for Filled Fiber Optic Cable

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-56-434	(1983; R 1991) Polyolefin Insulated Communication Cables for Outdoor Use

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA Bulletin 1755I-100	(1991; Rev thru Supple 10) List of Materials Acceptable for Use on Telephone Systems of REA Borrowers
REA Form 522	(1989) General Specification for Digital, Stored Program Controlled Central Office Equipment
REA PC-2	(1978) Splicing Plastic-Insulated Cables
REA PC-4	(1976) Acceptance Tests and Measurements of Telephone Plant
REA PE-22	(1982) Aerial and Underground Telephone Cable
REA PE-33	(1985) Shield Bonding Connectors
REA PE-39	(1987) Filled Telephone Cables
REA PE-60	(1979) Trunk Carrier Systems
REA PE-74	(1985) Filled Splice Closures
REA PE-87	(1983) Terminating (TIP) Cable
REA PE-89	(1985) Filled Telephone Cables with Expanded Insulation
REA TE&CM 635	(1962; Addenda 1 thru 4) Construction of Aerial Cable Plant
REA TE&CM 641	(1973) Construction of Buried Plant
REA TE&CM 644	(1983) Design and Construction of Underground Cable (Physical Plant)

REA TE&CM 823 (1980) Electrical Protection by Use of Gas Tube Arrestors

UNDERWRITERS LABORATORIES (UL)

UL 497 (1991; Rev Sep 1992) Protectors for Paired Conductor Communication Circuits

1.2 CONTRACTOR QUALIFICATIONS

1.2.1 Verification

The Contractor shall submit verification of the qualifications specified below with the shop drawings submittals. The Contractor shall have the following minimum qualifications in Telecommunications Systems.

1.2.1.1 The Contracting company shall have a minimum of five years experience in the design, application, installation and testing of the specified systems and equipment.

1.2.1.2 The Contractor shall employ industry trained personnel to perform systems engineering and design. All system designers and engineers shall have a minimum of three years experience on the specified system and all recommended components.

1.2.1.3 All supervisors and installers assigned to the installation of this system or any of its components shall have industry training for each area of installation. The supervisors and installers shall also have factory certification on all components used in the installation. General electrical trade staff (electricians) shall not be used for the installation of the fiber optic and copper telephone cables and associated hardware.

1.2.1.4 All installers assigned to the installation of this system or any of its components shall have a minimum of one year experience in the installation of the specified fiber optic and copper cable and associated hardware. Installation supervisors shall have a minimum of three years experience in the installation of the specified fiber optic and copper cable and associated hardware.

1.2.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of three years experience in producing the types of systems and equipment specified.

1.3 SUBMITTALS

Submit under provisions of Section 01300. Refer to Section 16010.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

Data

Spare Parts

Data lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of the detail drawings and not later than three months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Drawings

Telephone System

Detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts and installation instructions. Detail drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the cable system has been coordinated and will properly support the switching and transmission systems identified in the specification and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations. System drawings showing final configuration, including the location, gauge, pair, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector blocks layout at the termination points after installation.

Statements

Test Plans

Test plans shall define all tests required to ensure that the system meets specified requirement. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

Reports

Acceptance Tests

Test reports in booklet form showing all field tests performed, upon completion and testing of the installed system.

Installation Procedures

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Certificates

Where materials or equipment are specified to conform to the standards or publications and requirements of FCC, REA, ANSI, ASTM, NFPA, EIA/TIA, or UL, proof that the items furnished under this section of the specification conform to the specified requirements.

1.4 DELIVERY AND STORAGE

All cable shall be shipped on reels. The diameter of the drum shall be at least 13 times the diameter of the cable. The reels shall be substantial and so constructed as to prevent damage during shipment and handling. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from -40°C to +65°C, with relative humidity from 0 to 100 percent (0% to 100%). Equipment, other than cable, delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

PART 2. PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the

manufacturer's latest standard design that has been in satisfactory use for at least two years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment.

2.2 DISTRIBUTION FRAME

2.2.1 Copper Conductor Type, Main Distribution Frame (MDF)

The MDF provided shall be a modular type and shall meet all requirements of REA Form 522. The MDF shall be made of steel and treated to resist corrosion.

2.2.1.1 Protector Modules

The protector modules shall be of the three-electrode gas tube type. Protection modules shall be classified as light, medium, heavy, or maximum duty depending on their performance in categories of impulse life, maximum surge impulse and 60 Hz current carrying capacity as specified in REA TE&CM 823. The gas modules shall be fail-short and shall shunt high voltage to ground in less than 100 microseconds, shall have an external spark gap, and shall comply with UL 497.

2.2.2 Copper Conductor Type, Building Distribution Frame (BDF)

The BDF shall consist of a self-contained wall mounted unit providing a field cable stub, housing for termination and protector modules, and access for cross-connecting to inside wiring.

2.2.3 Fiber Optic Patch Panel

The patch-panels for the single-mode fiber shall be rack mountable fiber enclosures with 8.3/125 micron single-mode, ST-type feed-through couplers. The fiber enclosures shall come equipped with routing rings and tie down clamps for the fiber optic cable. Incoming fiber optic cables shall be terminated at the rear of the patch panel. Fiber optic patch cables for cross-connections shall be terminated on the front of the fiber patch panel. The number of ST couplers shall be based on the number of user outlets or fiber optic cable counts shown on project drawings. Panels shall be equipped with engraved laminated plastic nameplates above each connector.

2.3 CABLE

2.3.1 Copper Conductor Cable

Copper conductor cable shall conform to the following:

2.3.1.1 Underground.

REA PE-39 for cable smaller than 400 pair, and REA PE-39 or REA PE-89 for cable 400 pair or larger.

2.3.1.2 Fiber Optic Cable.

Reeled fiber optic cable shall contain 12 fibers and shall be of continuous manufacture with no factory splices in the fiber.

2.3.1.3 Compatible Components

Materials used within a given cable shall be compatible with all other materials used in the same cable when such materials come into intimate contact. All cable components used shall have no adverse affect on optical transmission or on the mechanical integrity characteristics of the fiber placed in the cable. All materials used shall be non-toxic, non-corrosive, and shall present no dermal hazard. The minimum required material components applied to fiber optic cable construction are central core or sheath strength member, color-coded optical fibers, inner jacket, pulling strength members, and outer jacket.

2.3.1.4 Cable Cores

A central core member shall be included to serve as a cable core foundation to reduce strain on the fibers but not to serve as a pulling strength member. The material of the central core member shall be nonmetallic. The sheath strength member may be either metallic or nonmetallic. The metallic strength element shall be spring quality music type wire per ASTM A 228. The nonmetallic strength element shall be glass filament.

2.3.1.5 Optical Fiber

Modular Design System

Single-mode optical fibers shall be contained in the cable. The core diameter, if an addressable parameter, shall be 8.5 microns plus or minus two microns (8.5_m ± 2_m). If the core diameter is not addressed, then the mode field diameter shall be 10 microns plus or minus one micron (10_m ± 1_m). The cladding diameter shall be 125 microns plus or minus five microns (125_m ± 5_m). The core-cladding offset shall be less than one micron (1_m). The minimum tensile strength of the fiber after primary protective coating shall be greater than 344 MPa (50,000 psi). The softening point of the clad material of the optical fiber shall be 1630°C plus or minus 50°C (1630°C ± 50°C)in compliance with ASTM C 338.

2.3.1.6 Optical Fiber Coatings

The optical fiber shall be coated with a suitable material to preserve the intrinsic high tensile strength of the glass fiber. The outside diameter of the coated optical fiber shall be 250 microns plus or minus 15 microns (250_m ± 15_m). The coating material shall be readily removable, mechanically or chemically, without damaging the optical fibers when the removal is desired.

2.3.1.7 Color Coding

The primary protective coated fiber shall be coated with a color-code coating for individual fiber identification. The maximum outside diameter of color-code coated fiber shall be less than 300 microns (300_m).

2.3.1.8 Fiber Protection

The color-code coated fibers shall be surrounded with either loose buffer tubes, channels or other innovative design, or in a tight buffer construction, for protection from external mechanical and environmental influences. The interior of the tube shall be filled with a suitable gel-filling compound to prevent water migration. The loose tube buffering, channel or other innovative design, or tight buffer construction, shall be color coded for the tube identification. The material of the buffering tube shall be PVC, mylar, nylon, or a functionally equivalent material.

2.3.1.9 Tint Requirements

The color concentrates or tints used to color the optical fibers and the buffer tubes shall not be susceptible to migration and chemical reaction with gel-filling compound.

2.3.1.10 Buffer Tubes

The buffer tubes shall be located concentrically around the cable central core member and covered with a black, low or medium density polyethylene inner jacket in accordance with ICEA S-56-434.

2.3.1.11 Filling Compound Requirements

The inner jacket interior and buffer cavity shall contain a gel-type filling compound. The filling compound shall be of suitable viscosity so that it shall protect the optical fibers against the ingress of water and/or soluble chemicals and shall not flow at the temperature of up to 65°C. The gel-filling compound shall be colorless, electrically non-conducting, inert gel-type, waterproof, non-toxic, with no dermal hazards, and compatible chemically and mechanically with all cable components and associated splice hardware materials to which it may make contact. The gel filling shall be removable, as required, using commercially available products under field conditions.

2.3.1.12 Tensile Strength

The cable shall contain a nonconductive central strength member as a well as a layer of aramid type yarn encircling the cable core. The strength member shall provide a maximum pulling load of 1335 Newtons.

2.3.1.13 Outer Jacket

Black, low or medium density, high-molecular weight, polyethylene materials shall be applied longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket, in accordance with ICEA S-56-434. The outer jacket shall be smooth, concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections. The overall outside cable diameter shall not exceed 19.1 mm (0.75 inch).

2.3.1.14 Armor Shield

A metallic armor shield shall be provided for additional tensile strength, rodent protection, and high crush and moisture resistance. The material of the metallic armoring shall be metallic tube or steel corrugation, coated with anti-corrosion material, and sealed at the longitudinal overlap.

2.3.1.15 Fiber Differentiation

The individual optical fiber shall be easily and positively identified from the buffer tube color code and the optical fiber primary coating color code.

2.3.1.16 Cable Labeling

The outer jacket shall bear the manufacturer's name, year of manufacture, and length marker. The length marking shall employ continuous four- or five-digit number in meters, such as:

Manufacturer's Name - Year
XXXX meter

The markings shall be repeated clearly and distinguishably, on every meter on the cable outer jacket. The marking ink shall be fully compatible with the jacket material, non-smearing, non-water soluble, abrasion resistant, and durable enough to withstand field handling during placement and subsequent operations.

2.3.1.17 Attenuation

The optical attenuation of each optical fiber in the reeled cable shall be

no greater than 1.0 dB/km within a peak emissive region of 850 to 1300 nm. The attenuation shall be measured on completed cable reel length, and normalized linearly to one km. The measurement method shall be in accordance with EIA/TIA 455-46A or EIA/TIA 455-53A.

2.3.1.18 Bandwidth

Each optic fiber within the cable (reeled) shall have its bandwidth measured between three dB optical power points, as compared to a reference signal, for a light source with a peak optical emissive region of 850 to 1300 nm. The effective system bandwidth of at least one GHz-km is required. The effective system bandwidth is the bandwidth length product calculated from the measured bandwidth multiplied by the cable length raised to the negative length dependence factor (or gamma factor). Gamma shall be in the range of 0.85 to 0.9. The bandwidth measurement shall be in accordance with EIA/TIA 455-54A FOTP-30 frequency domain or EIA/TIA 455-51A time domain.

2.3.1.19 Numerical Aperture

The numerical aperture of each optical fiber shall be 0.2 plus or minus 0.02 (0.2 ± 0.02) within an optical emissive region of 850 to 1300 nm. The method of numerical aperture measurement shall be in accordance with EIA/TIA 455-47A.

2.3.1.20 Bending Tolerance

The cable shall be able to withstand bending to a minimum radius of 10 times the cable outer diameter with no tensile load applied, and of twenty times the cable outer diameter with maximum tensile load applied during installation, without damage to cable components or degradation of the optical fiber performance at room temperature.

2.3.1.21 Tensile Load Tolerance

The fiber optic cable shall withstand a pull force of at least 1780 Newtons, to be applied to the pulling strength member during the installation and a tensile load of at least 300 Newtons during operation without incurring any damage or detriment to fiber optic cable and optical performance. The tensile strength test shall be per EIA/TIA 455-54A FOTP-33.

2.3.1.22 Cyclic Flexing Tolerance

The fiber optic cable shall withstand at least twenty bending cycles at minimum bend radius without damage to the fiber optic cable components or degrading optical performance. The cyclic flexing test shall be in accordance with EIA/TIA 455-65.

2.3.1.23 Crush Resistance

The minimum crush resistance of the fiber optical cable shall be greater than 650 Newton/cm without damage to cable components or degrading optical performance. The crush resistance test shall be in accordance with EIA/TIA 455-41.

2.3.1.24 Impact Resistance

The fiber optic cable shall be capable of withstanding twenty impacts, at a force of five Newtons-meters, without damage to cable components, or degradation of optical performance. The impact resistance test shall be in accordance with EIA/TIA 455-25A FOTP-25.

2.3.1.25 Gel Compound Temperature Tolerance

The optic cable shall be tested for the ability of the gel-filling compound in the interior of the inner jacket and buffer to resist flow at the temperature range of -40°C to +60°C in accordance with EIA/TIA 455-81A.

2.3.1.26 Fluid Penetration Test

The optic cable shall be capable of preventing the entry and axial migration of 62 kPa (9 psi) pressurized water when subjected to fluid penetration testing in accordance with EIA/TIA 455-54A FOTP-82.

2.3.1.27 Performance Requirements

The fiber optic cable shall comply with the mechanical performance requirements herein while used in duct applications where the temperature varies -20°C to +60°C. Optical performance degradation shall be less than five percent (5%) of the optical performance requirements in the temperature range of -20°C to +60°C. The fiber optic cable shall not be damaged in storage where the temperature may vary from -40°C to +65°C.

2.3.1.28 Defects and Imperfections

Fiber optic cables shall be free of material and manufacturing defects, and of dimensional non-uniformity’s which would seriously impair the functionality of the cables. The fiber optic cables shall also be free from surface imperfections and internal defects which would prevent them from meeting the mechanical and transmission requirements of this specification.

2.4 CONDUIT

Conduit as specified in Section 16415 ELECTRICAL WORK, INTERIOR and Section

16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown shall be furnished.

2.5 INNERDUCT

Innerduct shall be SIDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

2.6 CABLE TERMINALS

2.6.1 Cross-Connect Cable Terminal

Cross-connect cable terminals shall be weatherproofed for outdoor use and suitable for pole, pad, or stake mounting. The terminal shall be equipped with mounting columns and distribution rings for jumper-wire routing. The terminal shall be of aluminum or steel construction and ribbed for strength.

2.7 CABLE SPLICES, CONNECTORS, CABLE ASSEMBLIES, AND ORGANIZERS

2.7.1 Copper Cable Splices

Copper cable splices shall consist of a moisture resistant, two- or three-wire connector held rigidly in place to assure maximum continuity. The correct connector size shall be used to accommodate the cable gauge of the cable to be supplied. The connectors used shall be listed in REA Bulletin 1755I-100.

2.7.2 Fiber Optic Cable Splices

Fiber optic cable splices shall consist of a fusion splice where two fibers are thermally fused together forming a continuous fiber length.

2.7.3 Pre-Connectorized Single-Fiber Cable Assembly

Fiber cable connectors shall be the biconical type, field installable, self-aligning, and self-centering. The connectors shall be terminated on a 10-foot length of single-fiber cable. The single-fiber cable shall contain a buffered optical fiber of the same type and specification as that used in the multi-fiber cable.

2.7.4 Fiber Optic Splice Organizer

The splice organizer shall be suitable for housing fiber optic fusion splices in a neat and orderly fashion. The closure shall allow for a minimum of one meter of cable to be neatly stored without kinks or twists. The splice organizer in the closure shall provide individual strain relief for each splice. The case shall be suitable for reentry, if required for

future maintenance or modification, without damage to the cable or splices. All required splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors shall be provided in the organizer kit.

2.8 MISCELLANEOUS ITEMS

2.8.1 Shield Connectors

Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire. The connector shall be made of tin-plated tempered brass. Shield bond connectors shall comply with REA PE-33.

2.8.2 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. The braid shall be made from flat tin-plated copper.

2.8.3 Cable Warning Tape

Cable warning tape shall be a minimum of 75 mm wide, orange in color, and suitable for buried applications. The warning tape shall be continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 1.2 meter intervals.

2.8.4 Cable Warning Sign

Cable warning sign shall consist of one stake mounted warning sign. The stake shall be driven into undisturbed soil and the sign shall be mounted to the stake in accordance with the manufacturer's instructions.

PART 3. EXECUTION

3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All necessary interconnections, services, and adjustments required for a complete and operable telephone system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.

3.1.1 Underground Cable

Underground cable installation shall be accomplished in accordance with the requirements set forth in REA TE&CM 644. For cable installed in ducts and

conduit, a cable feeder guide shall be used between the cable reel, and the face of the duct and conduit to protect the cable and guide it into the duct and conduit as it is payed off the reel. As the cable is payed off the reel, it shall be inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is payed off the reel into the cable-feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-tension instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not be such that the cable is twisted or stretched.

3.1.2 Innerduct

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be sealed with polyurethane foam duct seal. This material shall be inserted between the innerduct and the duct. In those innerducts in which cables are placed this material shall also be inserted between the cable and the innerduct. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 50 mm (2 inches) exposed.

3.1.3 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of REA PE-60.

3.2 SPLICING

3.2.1 Copper Conductor Splices

Copper conductor cable splicing shall be accomplished in accordance with REA PC-2.

3.2.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with the manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices.

3.3 GROUNDING

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals shall be grounded.

3.3.1 Master Ground Bar (MGB)

The Contractor shall provide a copper MGB which shall be the hub of the basic grounding system providing a common point of connection for ground from outside cable, MDF, and equipment. The Contractor shall establish a MGB to ground resistance, including ground, of five Ohms or less.

3.3.2 Incoming Outside Plant Cables

3.3.2.1 Cable Entrance Ground Bar

The Contractor shall provide a Cable Entrance Ground Bar (CEGB) to which all incoming outside plant cable shields shall be bonded directly. The CEGB shall be a copper ground bar provided for the purpose of terminating incoming telephone cable shields on a common connector point. The CEGB shall be connected to the MGB by the most direct route utilizing a copper wire conductor with a total resistance of less than 0.01 Ohms.

3.3.2.2 Main Distribution Frame Ground Bar

All shields of cable stubs to connector block shall be bonded to the Main Distribution Frame Ground Bar (MDFB). The MDFB shall be established by the Contractor and shall consist of a copper ground bar at the bottom of the MDF used as the connection point for the cable stub shields to connector blocks and MDF protector assemblies.

3.3.2.3 Shields

The shields of all incoming cables shall not be bonded across the splice to the cable stubs. The shields of the incoming cables shall be grounded in the vault.

3.3.3 Manholes

The shields of all cables in each manhole shall be bonded together by a bonding wire or ribbon. At intermediate manholes where the cable is pulled through without a sheath opening, bonds are not required. If the manhole has a lacerating bonding ribbon, the shields of cable shall be attached to it.

3.4 ACCEPTANCE TESTS

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Notification of any

planned testing shall be given to the Contracting Officer at least 14 days prior to any test, and in no case shall notice be given until after the Contractor has received written Contracting Officer approval of the test plans as specified. The test plans shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

3.4.1 Copper Conductor Cable

The following acceptance tests shall be performed in accordance with REA PC-4:

3.4.1.0.0.0.1 Shield continuity

3.4.1.0.0.0.2 Conductor continuity.

3.4.1.0.0.0.3 Conductor insulation resistance

3.4.1.0.0.0.4 Structural return loss.

3.4.1.0.0.0.5 Cable insertion loss and loss margin at carrier frequencies.

3.4.1.0.0.0.6 Shield ground for single jacketed cables.

3.4.1.0.0.0.7 DC loop resistance.

3.4.2 Fiber Optic Cable

Three optical tests shall be performed: Optical Time Domain Reflectometry (OTDR) Test, Attenuation Test, and Bandwidth Test. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single-fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single-fiber cable assembly. The following acceptance tests shall be performed for each fiber in the completed cable length. Single-mode fibers do not require Bandwidth Test.

3.4.2.1 OTDR Test

The OTDR test shall be used to determine the adequacy of the cable installations. The OTDR tests will show any irregularities, such as discontinuities, micro-bends, improper splices, for the cable span under test. Hardcopy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, one km minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for

inspection of connector signature.

3.4.2.2 Attenuation Test

End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 850 nanometer light source at one end and the optical power meter on the other end. These tests will be used to verify that the cable system attenuation requirements are met. The measurement method shall be in accordance with EIA/TIA 455-53A.

3.4.2.3 Bandwidth Test

The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with EIA/TIA 455-54A FOTP-30.

END OF SECTION