

<b>SOLICITATION, OFFER, AND AWARD</b> <i>(Construction, Alteration, or Repair)</i>	1. SOLICITATION NUMBER <b>DACA67-99-B-0010</b>	2. TYPE OF SOLICITATION <input checked="" type="checkbox"/> SEALED BID (IFB) <input type="checkbox"/> NEGOTIATED (RFP)	3. DATE ISSUED <b>16 Nov 1998</b>	PAGE OF PAGES <b>1</b>
	<b>IMPORTANT - The "offer" section on the reverse must be fully completed by the offeror.</b>			
4. CONTRACT NUMBER <b>DACA67-99-C-0014</b>	5. REQUISITION/PURCHASE REQUEST NUMBER <b>W68MD9-8246-6160</b>	6. PROJECT NUMBER <b>PN: 43091</b>		
7. ISSUED BY <b>Seattle District, Corps of Engineers ATTN: CENWS-CT-CB PO Box 3755 Seattle, WA 98124-3755</b>	CONF <b>W68MD9</b>	8. ADDRESS OFFER TO <b>Seattle District, Corps of Engineers PO Box 3755 ATTN: CENWS-CT-CB-MU Seattle, WA 98124-3755</b>  <b>HAND CARRY: Preston Conference Room 4735 East Marginal Way South Seattle, WA 98134-2385</b> <b>BID OPENING ROOM: Preston Conference Room</b>		
9. FOR INFORMATION CALL	A. NAME <b>See Information Page inside Front Cover</b>	B. TELEPHONE NUMBER (include area code) (NO COLLECT CALLS) <b>See Information Page inside Front Cover</b>		

**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 number, date):

Furnish all labor, materials and equipment and perform all work for Centralized Fuel Station, Yakima Training Center, Washington, in accordance with the attached Contract Clauses, Special Clauses, Technical Specifications and Drawings.

1. Solicitation No. DACA67-99-B-0010 dated 11/16/98 with 10 amendments thereto
2. Wage Determination No. WA980001 with 13 modifications thereto & Wage Determination No. WA980013 with 2 modifications thereto.
3. Drawings as listed in Section 00800.

NOTE: This IFB is 100% Set-Aside for Small Businesses

11. The Contractor shall begin performance within 10 calendar days and complete it within 400 calendar days after receiving  award,  notice to proceed. This performance period is  mandatory,  negotiable. (See Paragraph SC-1)

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE PAYMENT BONDS? (If "YES," indicate within how many calendar days after award in item 12B.)  
 YES  NO

12B. CALENDAR DAYS 10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 0 copies to perform the work required are due at the place specified in Item 8 by local time 16 December 1998 (date). If this is a sealed bid solicitation, offers will 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. 2:00pm (hour)

B. An offer guarantee  is,  is not required.

C. 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)  
**SUPERIOR INDUSTRIAL MAINTENANCE CO., INC.**  
 PO BOX 940  
 HARRISBURG, NORTH CAROLINA 28075  
 Tax ID No: 56-1779224 DUNS No: 79-661-2679  
 eMail: \_\_\_\_\_  
 CND# 0UMK5 FACILITY CODE \_\_\_\_\_

15. TELEPHONE NUMBER (include area code) | FAX:704-795-0008  
704-795-0001  
 18. REMITTANCE ADDRESS (Include only if different than from 14)

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

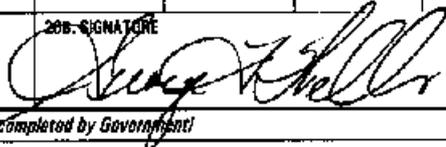
AMOUNTS  See page 00010-4

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

**19. ACKNOWLEDGEMENT OF AMENDMENTS**  
 (The offeror acknowledges receipt of amendments to the solicitation - give number and date of each)

AMENDMENT NO.	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010
DATE	11-24-98	12-1-98	12-3-98	12-11-98	1-6-99	12-28-98	1-13-98	1-19-98	1/20/99	1/22/99

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)  
 George F. Wells, PROJECT MANAGER

20B. SIGNATURE  


20C. OFFER DATE  
 1/28/99.

**AWARD (To be completed by Government)**

21. ITEMS ACCEPTED  
 0001

22. AMOUNT  
 \$3,847,326.00

23. ACCOUNTING AND APPROPRIATION DATA  
 2192050000 088082  
 32000029CT1043091000 E308 35026

24. SUBMIT INVOICES TO ADDRESS SHOWN IN (4 copies unless otherwise specified) 

26. ADMINISTERED BY  
 Fort Lewis Area Office  
 USAED, Seattle  
 PO Box 92146  
 Tillicum, WA 98492-0146

25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO  
 10 U.S.C. 2304(c) |  41 U.S.C. 253(c) |

27. PAYMENT WILL BE MADE BY  
 US Army Corps of Engineers Finance Center  
 CEFC-AO-P  
 5720 Integrity Drive  
 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 the issuing office.) Contractor agrees to furnish and deliver all items or perform all work requirements identified on this form and any continuation sheets for the consideration stated 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 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)  
 Cheryl A. Anderson, Contracting Officer

30B. SIGNATURE

30C. DATE

31B. UNITED STATES OF AMERICA  


31C. AWARD DATE  
 8 Feb 99

IFB No: DACA67-99-B-0010

Contract No.: DACA67-99-C-0014

IF THE CONTRACTOR IS A CORPORATION OR PARTNERSHIP, THE APPLICABLE FORM LISTED BELOW MUST BE COMPLETED. IN THE ALTERNATIVE, OTHER EVIDENCE MUST BE SUBMITTED TO SUBSTANTIATE THE AUTHORITY OF THE PERSON SIGNING THE CONTRACT. IF A CORPORATION, THE SAME OFFICER SHALL NOT EXECUTE BOTH THE CONTRACT AND THE CERTIFICATE.

**CORPORATE CERTIFICATE**

I, David M. White, certify that I am the Corporate Secretary of the corporation named as Contractor herein; that George H. Wells, who signed this contract on behalf of the Contractor was then Project Manager of said corporation; that said contract was duly signed for and on behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

  
 (Secretary) **CORPORATE SEAL**  
 David M. White

**AUTHORITY TO BIND PARTNERSHIP**

This is to certify that the names, signatures and Social Security Numbers of all partners are listed below and that the person signing the contract has authority actually to bind the partnership pursuant to its partnership agreements. Each of the partners individually has full authority to enter into and execute contractual instruments on behalf of said partnership with the United States of America, except as follows: (state "none" or describe limitations, if any).

This authority shall remain in full force and effect until such time as the revocation of authority by any cause whatsoever has been furnished in writing to, and acknowledged by, the Contracting Officer.

(Names, Signatures and Social Security Numbers of all Partners)

NAME	SIGNATURE	SOCIAL SECURITY NO.
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

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REISSUED SCHEDULE

## SCHEDULE

<u>Item No.</u>	<u>Description of Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Amount</u>
BASE ITEM					
0001	All Work for Project Entitled Centralized Fuel Station, Except for Item 0002	1	JOB	LS	\$ <u>3,847,326.00</u> / <u>100</u>
<i>(THREE MILLION EIGHT HUNDRED FORTY SEVEN THOUSAND THREE HUNDRED TWENTY SIX AND 00/100 DOLLARS)</i>					
ADDITIVE OPTIONAL ITEM					
0002	Gravel Wearing Course, PCC Turning Pad, and Culverts as Shown on Plates C-2, C-6 and C-4	1	JOB	LS	\$ <u>327,217.00</u>
<i>(THREE HUNDRED TWENTY SEVEN THOUSAND TWO HUNDRED SEVENTEEN AND 00/100 DOLLARS)</i>					
TOTAL ITEMS					\$ <u>4,174,543.00</u>
<i>(FOUR MILLION ONE HUNDRED SEVENTY FOUR THOUSAND FIVE HUNDRED FORTY THREE AND 00/100 DOLLARS)</i>					

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FROM: US ARMY ENGR DIST, SEATTLE  
PO BOX 3755  
SEATTLE, WA. 98124-3755  
(206) 764-3266, CENWS-CT-CB-MU, Elizabeth Keys

1. Refer to Invitation for Bids No. DACA67-99-B-0010, dated 16 Nov 98, entitled Centralized Fuel Station, Yakima Training Center, Washington.

2. The Bid Opening time and date remain 1:00 PM, Local Time, 28 Jan 1999.

3. This Amendment Ten (0010), dated 22 Jan 99, and provides for the following wage rate clarification as well as specification and drawing changes.

4. General Decision WA980013 (Building) incorporated by Amendment No. 0002 is for all building work. General Decision WA980001 (Dredging, Heavy, Highway) incorporated by Amendment No. 0009 applies to all other work.

5. SPECIFICATION Changes:

a) Section 00800 - SPECIAL CLAUSES (MODIFICATIONS TO DRAWINGS BY NOTATION), R0005, page 00800-11:

(1) Sheet 56, PL. E-3: Change "Sketch 16" to "Sketch 15".

(2) Sheet 57, PL. E-4, modification a): Change "Sketch 17" to "Sketch 16".

b) Section 02510 - WATER DISTRIBUTION SYSTEM: Add last sentence to paragraphs 2.3.1 and 2.3.2.1 as follows, "Joint material shall be fuel resistant."

c) Section 13202 - FUEL STORAGE SYSTEMS:

(1) Add last sentence to paragraph 2.14.1 Product Piping, as follows, "Transfer piping to/from receiving and issuing headers and piping to tracked vehicle island and retail islands may be any pipe material specified in this paragraph."

(2) Revise paragraph 1.14.8.9 Butterfly Valves to read as follows, "Valves shall meet the performance requirements of MSS-SP-68. Valve materials shall be stainless steel or interior coated carbon steel. All wetted materials shall be compatible with jet fuel. Valves shall be in accordance with API 607 and API 609, and feature a bi-directional backup metal seat fire seal. Valves shall be ANSI 150 pound rated lug style with bi-directional shut-off and end of line pressure rating to the full ANSI shut-off pressure. Manual valve handle actuators shall be weatherproof, and oriented to indicate position indication."

6. DRAWING Changes:

a) Sketch 17 (R0005), attached to Section 00800-SPECIAL CLAUSES: Revise NOTE 1 to read as follows, "48 pair fiber optic cable shall be run from DCO to Range Control. From DCO, run 48 pair fiber optic cable in conduit as designated by DOIM in existing manholes and conduit to existing Telephone Hut Manhole shown on Sketch 16 (R0005). From Telephone Hut Manhole, exit manhole in Contractor-provided 53 mm PVC conduit, concrete encased, to nearest telephone pole approximately 32 meters east of Telephone Hut Manhole. Install necessary ancillary equipment to convert pole into a riser pole. Equipment shall include 53 mm PVC conduit on pole. Run 48 pair fiber optic cable from

riser telephone pole to Range Control along side of pole opposite existing fiber optic line on existing telephone poles."

b) Sheet 57, Plate E-4, Zone E3: Remove callout "48 Fiber Aerial Fiber Optic Cable 8.3/125u Single Mode See Note 1".

7. NOTICE TO BIDDERS: BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS AMENDMENT BY NUMBER AND DATE ON BID OR BY TELEGRAM BEFORE BID OPENING. PLEASE ALSO MARK OUTSIDE OF ENVELOPE CONTAINING BID TO SHOW AMENDMENT RECEIVED.

**AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT**

2. AMENDMENT/MODIFICATION NO. 0009		3. EFFECTIVE DATE 01/20/99	4. REQUISITION/PURCHASE REQ. NO. W68ND9-8246-6160	5. PROJECT NO. (IF APPLICABLE) 41091
6. ISSUED BY SEATTLE DIST. CORPS OF ENGRS PO BOX 3755 SEATTLE WA 98124-3755  Elizabeth M. Keys		CODE DACA67	7. ADMINISTERED BY (If other than Item 6) FORT LEWIS AREA OFFICE BLDG 9031, 5TH & DEARBORN  FT LEWIS, WA 98433	
		CD3 (206) 764-3266	CODE 03M1T00	

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code): Vendor ID: 00000000		9A. AMENDMENT OF SOLICITATION NO. DACA67-99-B-0010
		9B. DATED (SEE ITEM 11) 11/16/98
		10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED (SEE ITEM 12)

CODE \_\_\_\_\_ FACILITY CODE \_\_\_\_\_

**11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS**

The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers  is extended,  is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning \_\_\_\_\_ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (if required)

**13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.**

(X)	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103 (b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor  is not,  is required to sign this document and return \_\_\_\_\_ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

PROJECT Centralized Fuel Station  
Yakima Training Center WA

A This Amendment is issued to incorporate an additional wage rate into the solicitation. General Decision No. WA980001, modification number 13, publication date 1/8/99, for the State of Washington (Dredging, Heavy, Highway) is hereby added. This wage rate is in addition to the General Decision No. WA980013,

Except as provided herein, all terms and conditions of the document referenced in item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)	

SF 30 CONTINUATION SHEET

(2) Revisions to drawings by notation in the Special Clauses.

(3) Revision 'A' to drawing sheets 16, 22, 26 and 29.

B. The attached revised drawings replace corresponding drawings. The attached revised specification sections supersede and replace corresponding specification sections and are to be inserted in sequence.

Specification changes are shown lined out for deletions and underlined for additions with a vertical line in the margin.

C. The bid opening time and date is changed to:

1:00 PM, Local Time, 20 January 1999

D. NOTICE TO BIDDERS: BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS AMENDMENT BY THE NUMBER AND DATE ON THE BID OR BY TELEGRAM BEFORE THE BID OPENING. PLEASE ALSO MARK OUTSIDE OF ENVELOPE IN WHICH BID IS ENCLOSED TO SHOW THE AMENDMENT(S) RECEIVED.

Enclosures:

Revised 00010-4  
Revised Section 00800, pages 00800-1 - 00800-32  
Revised Section 01000, pages 01000-i - 01000-iii  
Revised Section 01005, pages 01005-1 - 01005-2  
Revised Section 01025, pages 01025-1 - 01025-3  
Revised Section 01702, pages 01702-1 - 01702-3  
Revised Section 02754, pages 02754-1 - 02754-20  
Revised Section 02831, pages 02831-1 - 02831-4  
New Section 02935, pages 02935-1 - 02935-5  
Revised Section 11303, pages 11303-1 - 11303-10  
Revised Section 13202, pages 13202-1 - 13202-43  
Revised Section 13205, pages 13205-1 - 13205-34  
Deleted Section 15951, pages 15951-1 - 15951-14  
Revised Section 16375, pages 16375-1 - 16375-29  
Revised Section 16415, pages 16415-1 - 16415-29  
Revised Section 16742, pages 16742-1 - 16742-6

FROM: US ARMY ENGR DIST, SEATTLE  
PO BOX 3755  
SEATTLE, WA 98124-2255  
(206) 764-3266, CENWS-CT-CB-MU, Elizabeth Keys

1. Refer to Invitation for Bids DACA67-99-B-0010, dated 16 Nov 98, entitled Centralized Fuel Station, Yakima Training Center WA.

2. This Amendment Eight (0008), dated 19 Jan 99, provides for the following:

THE BID OPENING TIME AND DATE HAS BEEN CHANGED  
TO 1:00 PM LOCAL TIME, 28 JAN 99.

3. Amendment No. Nine (0009) which incorporates Davis-Bacon General Decision No. WA980001 will be forthcoming.

4. NOTICE TO BIDDERS: Bidders must acknowledge receipt of this amendment by number and date on bid or by telegram before bid opening. Please mark outside of envelope in which bid is enclosed to show amendment received.

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FROM: US ARMY ENGR DIST, SEATTLE  
PO BOX 3755  
SEATTLE, WA. 98124-3755  
(206) 764-6588, CENPS-CT-MU, Elizabeth Keys

1. Refer to Invitation for Bids No. daca-99-B-0010, Entitled "Centralized Fuel Station, Yakima Training Center, Washington"
2. The Bid Opening time and date remain: 1:00 PM, Local Time, 20 January 1999.
3. This is Amendment Seven (0007), dated 13 Jan 99, and provides for the following specification and drawing changes.

4. SPECIFICATIONS:

a) Reissued Schedule Item 0002: Change "OPTIONAL ITEM" to "ADDITIVE ITEM".

b) Section 00800 - SPECIAL CLAUSES (MODIFICATIONS TO DRAWINGS BY NOTATION), page 00800-10: Change Sheet 32 modification (1) to "..from butterfly to full port ball valves (6 places)." Change modification (2) to "..to full port ball valves (28 places)."

c) Table of Contents: Change Section 02241 title to "Aggregate Base Course and Gravel Wearing Course".

d) Section 02241 - AGGREGATE BASE COURSE:

(1) Change the title to "AGGREGATE BASE COURSE AND GRAVEL WEARING COURSE".

(2) Add paragraph 2.1.4 as follows:

"2.1.4 Gravel Wearing Course Gradation Requirements

Gradation requirements specified in TABLE I shall apply to the completed aggregate surface. It shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. TABLE I shows permissible gradings for granular material used in aggregate surface roads and airfields. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION FOR GRAVEL WEARING COURSE

<u>Sieve Designation</u>	<u>No. 1</u>	<u>No. 2</u>
25.0 mm	100	100
9.5 mm	50-85	60-100
4.7 mm	35-65	50-85
2.00 mm	25-50	40-70
0.425 mm	15-30	24-45
0.075 mm	8-15	8-15

(TABLE I. GRADATION FOR GRAVEL WEARING COURSE)

<u>Sieve Designation</u>	<u>No. 1</u>	<u>No. 2</u>
1 in.	100	100

3/8 in.	50-85	60-100
No. 4	35-65	50-85
No. 10	25-50	40-70
No. 40	15-30	24-45
No. 200	8-15	8-15"

e) Section 13202 - FUEL STORAGE SYSTEMS

(1) Remove second sentence in paragraph 2.10.1, "Pump and meter .. submerged in the product."

(2) Remove last sentence in paragraph 2.14.6, "Stainless steel pipe 150 mm .. for pipe 300 mm (12 inches) and smaller."

(3) Revise fourth sentence of paragraph 2.14.8.8 to read, "Valves shall be provided with a factory or field fabricated fusible link type valve operator."

(4) Revise second sentence of paragraph 2.14.8.9 to read, "Valve materials shall be stainless steel when installed on stainless steel pipe, interior or coated carbon steel when installed on interior coated carbon steel pipe, or carbon steel when installed on other pipe."

f) Section 15400 - PLUMBING, GENERAL PURPOSE, paragraph 2.12: Remove "controls" from the second sentence.

5. DRAWING Sheet 31, Plate M-2, AIR COMPRESSOR SCHEDULE: Change AC-1 Volts/Hertz/Phase to "460/60/3".

6. Section 00100 is revised to add contract clause 52.236-7007, Additive or deductive Items as follows:

252.236-7007 ADDITIVE OR DEDUCTIVE ITEMS (DEC 1991)

(a) The low offeror and the items to be awarded shall be determined as follows--

(1) Prior to the opening of bids, the Government will determine the amount of funds available for the project.

(2) The low offeror shall be the Offeror that--

(i) Is otherwise eligible for award; and

(ii) Offers the lowest aggregate amount for the first or base bid item, plus or minus (in the order stated in the list of priorities in the bid schedule) those additive or deductive items that provide the most features within the funds determined available.

(3) The Contracting Officer shall evaluate all bids on the basis of the same additive or deductive items.

(i) If adding another item from the bid schedule list of priorities would make the award exceed the available funds for all offerors, the Contracting Officer will skip that item and go to the next item from the bid schedule of priorities; and

(ii) Add that next item if an award may be made that includes that item and is within the available funds.

(b) The Contracting Officer will use the list of priorities in the bid schedule only to determine the low offeror. After determining the low offeror, an award may be made on any combination of items if--

(1) It is in the best interest of the Government;

(2) Funds are available at the time of award; and

(3) The low offeror's price for the combination to be awarded is less than the price offered by any other responsive, responsible offeror.

(c) Example. The amount available is \$100,000. Offeror A's base bid and four additives (in the order stated in the list of priorities in the bid Schedule) are \$85,000, \$10,000, \$8,000, \$6,000, and \$4,000. Offeror B's base bid and four additives are \$80,000, \$16,000, \$9,000, \$7,000, and \$4,000. Offeror A is the low offeror. The aggregate amount of offeror A's bid for purposes of award would be \$99,000, which includes a base bid plus the first and fourth additives. The second and third additives were skipped because each of them would cause the aggregate bid to exceed \$100,000.

(End of provision)

6. NOTICE TO BIDDERS: BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS AMENDMENT BY NUMBER AND DATE ON BID OR BY TELEGRAM. PLEASE ALSO MARK OUTSIDE OF ENVELOPE CONTAINING BID TO SHOW AMENDMENT RECEIVED.

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FROM: US ARMY ENGR DIST, SEATTLE  
PO BOX 3755  
SEATTLE, WA 98124-3755  
(206) 764-3266, CENWS-CT-CB-MU, Elizabeth Keys

1. Refer to Invitation for Bids DACA67-99-B-0010, dated 16 Nov 98, entitled: Centralized Fuel Station, Yakima Training Center, WA.

2. This is Amendment Six (0006), dated 28 Dec 98, which provides for extension of the bid opening time and date as follows:

THE BID OPENING TIME AND DATE IS EXTENDED  
TO 2:00 P.M., LOCAL TIME, on 14 JAN 99.

3. Amendment No. Five (0005), with technical changes, is being prepared and will be issued on or about 4 Jan 99 on floppy discs.

4. NOTICE TO BIDDERS: Bidders must acknowledge receipt of this amendment by number and date on bid or by telegram before bid opening. Please mark outside of envelope in which bid is enclosed to show the amendment was received.

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<b>AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT</b>				1. CONTRACT ID CODE	PAGE OF PAGES 1 2
2. AMENDMENT/MODIFICATION NO. 0005		3. EFFECTIVE DATE 01/06/99	4. REQUISITION/PURCHASE REQ. NO. W68MD9-8246-6160	5. PROJECT NO. (If applicable) 43091	
6. ISSUED BY SEATTLE DIST. CORPS OF ENGRS PO BOX 3755 SEATTLE WA 98124-3755  Elizabeth M. Keys		CODE DACA67	7. ADMINISTERED BY (if other than item 6) PORT LEWIS AREA OFFICE BLDG 9031, 5TH & DEARBORN  FT LEWIS, WA 98433		CODE G3M1T00
8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) Vendor ID: 00000000			<input checked="" type="checkbox"/> X  <input type="checkbox"/>	9A. AMENDMENT OF SOLICITATION NO. DACA67-99-B-0010	
CODE				9B. DATED (SEE ITEM 11) 11/16/98	
FACILITY CODE			10A. MODIFICATION OF CONTRACT/ORDER NO.		
			10B. DATED (SEE ITEM 13)		
<b>11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS</b>					
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers <input checked="" type="checkbox"/> is extended, <input type="checkbox"/> is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning <u>1</u> copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.					
12. ACCOUNTING AND APPROPRIATION DATA (if required)					
<b>13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.</b>					
(X)	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.				
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation data, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103 (b).				
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:				
	D. OTHER (Specify type of modification and authority)				
<b>C. IMPORTANT:</b> Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.					
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)					
PROJECT: Centralized Fuel Station Yakima Training Center WA					
A. This amendment provides for:					
(1) Revisions to the SCHEDULE (00010), SPECIAL CLAUSES (00800), Table of Contents (01000) and Sections 01005, 01025, 01754, 02831, 02935, 11303, 13202, 13205, 15951, 16375, 16415, and 16742.					
Except as provided herein, all terms and conditions of this document referenced in item 8A or 10A, as heretofore changed, remains unchanged and in full force and effect.					
15A. NAME AND TITLE OF SIGNER (Type or print)			16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)		
15B. CONTRACTOR/OFFEROR		15C. DATE SIGNED	16B. UNITED STATES OF AMERICA		16C. DATE SIGNED
(Signature of person authorized to sign)			BY _____		(Signature of Contracting Officer)

SF 30 CONTINUATION SHEET

(2) Revisions to drawings by notation in the Special Clauses.

(3) Revision 'A' to drawing sheets 16, 22, 26 and 29.

B. The attached revised drawings replace corresponding drawings. The attached revised specification sections supersede and replace corresponding specification sections and are to be inserted in sequence.

Specification changes are shown lined out for deletions and underlined for additions with a vertical line in the margin.

C. The bid opening time and date is changed to:

1:00 PM, Local Time, 20 January 1999

D. NOTICE TO BIDDERS: BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS AMENDMENT BY THE NUMBER AND DATE ON THE BID OR BY TELEGRAM BEFORE THE BID OPENING. PLEASE ALSO MARK OUTSIDE OF ENVELOPE IN WHICH BID IS ENCLOSED TO SHOW THE AMENDMENT(S) RECEIVED.

Enclosures:

Revised 00010-4  
Revised Section 00800, pages 00800-1 - 00800-32  
Revised Section 01000, pages 01000-i - 01000-iii  
Revised Section 01005, pages 01005-1 - 01005-2  
Revised Section 01025, pages 01025-1 - 01025-3  
Revised Section 01702, pages 01702-1 - 01702-3  
Revised Section 02754, pages 02754-1 - 02754-20  
Revised Section 02831, pages 02831-1 - 02831-4  
New Section 02935, pages 02935-1 - 02935-5  
Revised Section 11303, pages 11303-1 - 11303-10  
Revised Section 13202, pages 13202-1 - 13202-43  
Revised Section 13205, pages 13205-1 - 13205-34  
Deleted Section 15951, pages 15951-1 - 15951-14  
Revised Section 16375, pages 16375-1 - 16375-29  
Revised Section 16415, pages 16415-1 - 16415-29  
Revised Section 16742, pages 16742-1 - 16742-6

FROM: US ARMY ENGR DIST, SEATTLE  
PO BOX 3755  
SEATTLE, WA 98124-2255  
(206) 764-3266, CENWS-CT-CB-MU, Elizabeth Keys

1. Refer to Invitation for Bids DACA67-98-B-0010, dated 16 Nov 98, entitled: Centralized Fuel Station, Yakima Training Center.

2. This Amendment Four (0004), dated 11 Dec 98, provides for the following:

THE BID OPENING TIME AND DATE HAS BEEN CHANGED  
TO 2:00 PM LOCAL TIME, 7 JAN 99.

3. In addition, the following changes are incorporated. Clause FAR 52.219-2 EQUAL LOW BIDS (OCT 1995) in SECTION 00600 is deleted in its entirety. Clause 52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EEO (APR 1984) in SECTION 00700 is revised to read: MINORITY GOALS FOR WA: 9.7% IN YAKIMA COUNTY. The goal for PIERCE COUNTY is deleted while the FEMALE PARTICIPATION goal remains unchanged in this clause. (Offerors are encouraged to review Clause 52.222-26 EQUAL OPPORTUNITY, SECTION 00700, in conjunction with Clause 52.222-23).

4. Amendment No. Five (0005) with technical changes will be forthcoming.

4. NOTICE TO BIDDERS: Bidders must acknowledge receipt of this amendment by number and date on bid or by telegram before bid opening. Please mark outside of envelope in which bid is enclosed to show amendment received.

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**AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT**

1. CONTRACT ID CODE  
PAGE OF PAGE  
2 5

2. AMENDMENT/MODIFICATION NO. 0003	3. EFFECTIVE DATE 12/03/98	4. REQUISITION/PURCHASE REQ. NO. W60MD9-8246-6160	5. PROJECT NO. (if applicable) 43091
6. ISSUED BY SEATTLE DIST. CORPS OF ENGRS PO BOX 3755 SEATTLE WA 98124-3755  Elizabeth M. Keys	CODE DACA67  C03 (206) 764-3266	7. ADMINISTERED BY (if other than item 6) FORT LEWIS AREA OFFICE BLDC 9031, 5TH & DEARBORN  FT LEWIS, WA 98433	

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) Vendor ID: 00000000	<input checked="" type="checkbox"/>	9A. AMENDMENT OF SOLICITATION NO. DACA67-99-B-0010
	<input type="checkbox"/>	9B. DATED (SEE ITEM 11) 11/16/98
	<input type="checkbox"/>	10A. MODIFICATION OF CONTRACT/ORDER NO.
	<input type="checkbox"/>	10B. DATED (SEE ITEM 13)

CODE FACILITY CODE

**11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS**

The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers  is extended,  is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (if required)

**13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.**

<input checked="" type="checkbox"/>	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
<input type="checkbox"/>	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103 (b).
<input type="checkbox"/>	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
<input type="checkbox"/>	D. OTHER (Specify type of modification and authority)

**E. IMPORTANT:** Contractor  is not,  is required to sign this document and return \_\_\_\_\_ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

PROJECT: Construct Centralized Pole Station  
Yakima Training Center, WA

A. This Amendment is issued to incorporate changes to SECTION 16375  
ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and to provide an Attendees  
list from the Site Visit.

Except as provided herein, all terms and conditions of the document referenced in item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)	16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)
15B. CONTRACTOR/OFFEROR  (Signature of person authorized to sign)	16B. UNITED STATES OF AMERICA  BY _____ (Signature of Contracting Officer)
15C. DATE SIGNED	16C. DATE SIGNED

SF 30 CONTINUATION SHEET

B. The attached Pages 16375-14 through 16735-15, marked R0003 in the lower right-hand corner, are to be substituted in SECTION 16375. Side bars and Underscoring denotes the location of the changes.

C. The List of Attendees from the Site Visit at Yakima Training Center WA on 1 December 1998 is also attached.

D. The bid opening time and date remain:

2:00 PM (Local Time) on 16 December 1998

E. Bidders MUST acknowledge receipt of this amendment by number and date on the submitted bid or by telegram before bid opening. Please mark the outside of the envelope in which the bid is submitted to show receipt of the amendment.

**AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT**

2. AMENDMENT/MODIFICATION NO. 0002		3. EFFECTIVE DATE 12/01/98	4. REQUISITION/PURCHASE REQ. NO. W68MD9-8246-6160	5. PROJECT NO. (if applicable) 43092
6. ISSUED BY SEATTLE DIST. CORPS OF ENGRS PO BOX 3755 SEATTLE WA 98124 3755  Elizabeth M. Keys	CODE DACA67	7. ADMINISTERED BY (if other than item 6) PORT LEWIS AREA OFFICE BLDG 9031, 5TH & DEARBORN  FT LEWIS, WA 98433		CODE G3M1T0
8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) Vendor ID:		(X)	9A. AMENDMENT OF SOLICITATION NO. DACA67-99-B-0010	
		X	9B. DATED (SEE ITEM 11) 11/16/98	
			10A. MODIFICATION OF CONTRACT/ORDER NO.	
			10B. DATED (SEE ITEM 13)	
CODE	FACILITY CODE			

**11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS**

The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers  is extended,  is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning \_\_\_\_\_ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (if required)

**13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.**

(X)	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103 (b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor  is not,  is required to sign this document and return \_\_\_\_\_ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Project: Construct Centralized Fuel Station, Yakima Training Center, Washington.  
DACA67-99-B-0010, Amendment No. 0002

This amendment No. 0002 is issued to incorporate correct wage rates in to the solicitation.

General Decision No WA980002 dated 11/20/98 is deleted in its

Except as provided herein, all terms and conditions of the document referenced in item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)	

SF 30 CONTINUATION SHEET

entirety.

\* 2. General Decision WA980013 dated 07/11/98, pages 1 through 4, for Yakima County, is added.

B. The bid opening time and date remain:

2:00 PM (Local Time), 16 December 1998.

C. Bidders must acknowledge receipt of this amendment by number and date on submitted bid or by telegram before bid opening. Please mark the outside of the envelope in which bid is submitted to show receipt of the amendment.

**AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT**

1. CONTRACT ID CODE PAGE OF PAGES  
 1 2

2. AMENDMENT/MODIFICATION NO. 0001	3. EFFECTIVE DATE 11/24/98	4. REQUISITION/PURCHASE REQ. NO. W58MD9-8246-6160	5. PROJECT NO. (If applicable) 43091
6. ISSUED BY SEATTLE DIST, CORPS OF ENGRS PO BOX 3755 SEATTLE WA 98124-3755 Elizabeth M. Keys	CODE DACA67 COJ (206) 764-3266	7. ADMINISTERED BY (If other than item 5) FORT LEWIS AREA OFFICE BLDG 9031, 5TH & DEARBORN FT LEWIS, WA 98433	

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) Vendor ID: 00000000	<input checked="" type="checkbox"/>	9A. AMENDMENT OF SOLICITATION NO. DACA67-99-B-0010
	<input type="checkbox"/>	9B. DATED (SEE ITEM 11) 11/16/98
	<input type="checkbox"/>	10A. MODIFICATION OF CONTRACT/ORDER NO.
	<input type="checkbox"/>	10B. DATED (SEE ITEM 13)
CODE	FACILITY CODE	

**11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS**

The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers  is extended,  is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

\*2. ACCOUNTING AND APPROPRIATION DATA (If required)

**13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.**

<input checked="" type="checkbox"/>	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
<input type="checkbox"/>	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103 (b).
<input type="checkbox"/>	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
<input type="checkbox"/>	D. OTHER (Specify type of modification and authority)

**E. IMPORTANT:** Contractor  is not,  is required to sign this document and return \_\_\_\_\_ copies to the issuing office.

**14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)**

PROJECT: Construct Centralized Fuel Station  
 Yakima Training Center, WA

A. This Amendment is issued to incorporate a modification to the Wage Rate WA980002 in SECTION 00800. Accordingly, General Wage Decision No. WA980002, Modification 14 published 10/16/98, pages WA980002-1 through WA980002-25, is replaced with the attached Modification 15 published 11/20/98, pages WA980002-1 through WA980002-26.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
_____ (Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)	

SF 30 CONTINUATION SHEET

B. The bid opening time and date remain:

2:00 PM (Local Time), 16 Dec 1998

C. Bidders MUST acknowledge receipt of this amendment by number and date on submitted bid or by telegram before bid opening. Please mark the outside of the envelope in which the bid is submitted to show receipt of the amendment.

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## SECTION 00700

## CONTRACT CLAUSES

## 1 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at these addresses:

<http://www.arnet.gov/far>  
<http://farsite.hill.af.mil>  
<http://www.dtic.mil/dfars>  
 (End of clause)

## 2 52.201-4001 SUCCESSOR CONTRACTING OFFICERS (52.0201-4001)

The Contracting Officer who signed this contract is the primary Contracting Officer for the contract. Nevertheless, any Contracting Officer assigned to the Seattle District and acting within his/her authority may take formal action on this contract when a contract action needs to be taken and the primary Contracting Officer is unavailable.

## 3 52.201-7000 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)

(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)

## 4 52.202-1 I DEFINITIONS (OCT 1995)--ALTERNATE I (APR 1984)

(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 (e)(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 (e)(1) or (e)(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)

5 52.203-3 GRATUITIES (APR 1984)

(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) above, 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)

(R 7-104.16 1952 MAR)

6 52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)

(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 annul 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 on any basis other than the merits of the matter.

(End of clause)  
 (R 7-103.20 1958 JAN)  
 (R 1-1.503)  
 (R 1-7.102-18)

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

(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 over 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)

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

(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 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 subsection 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)

9 52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(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.

(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) The 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)

10 52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS  
(JUN 1997)

(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 Congress, or an 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 or 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 his 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 or 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 attempt 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)

11 52.203-7001 SPECIAL PROHIBITION ON EMPLOYMENT (JUN 1997)

(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 first-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.

(e) 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 identity and relationship of the parties, in all first-tier subcontracts exceeding the simplified acquisition threshold in Part 2 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) 616-3507.

(End of clause)

12 52.204-4 PRINTING/COPYING DOUBLE-SIDED ON RECYCLED PAPER (JUN 1996)

(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 standard is 50 percent recovered material content of certain industrial by-products.

(End of clause)

13 52.204-7003 CONTROL OF GOVERNMENT PERSONNEL WORK PRODUCT (APR 1992)

The Contractor's procedures for protecting against unauthorized disclosure of information shall not require Department of Defense employees or members of the Armed Forces to relinquish control of their work products, whether classified or not, to the Contractor.

(End of clause)

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

(a) The Government suspends or debar Contractors to protect the Government's interest. 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 reason(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 interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(End of clause)

15 52.209-7004 SUBCONTRACTING WITH FIRMS THAT ARE OWNED OR CONTROLLED BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) Unless the Government determines that there is a compelling reason to do so, the Contractor shall not enter into any subcontract in excess of \$25,000 with a firm, or a subsidiary of a firm, that is identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country.

(b) 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 identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country. The notice must include the name of the proposed subcontractor and the compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded From Federal Procurement and Nonprocurement Programs.

(End of clause)

16 52.214-26 AUDIT AND RECORDS--SEALED BIDDING (OCT 1997)

(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 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)

17 52.214-27 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS  
--SEALED BIDDING (OCT 1997)

(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) above.

(c) Any reduction in the contract price under paragraph (b) above 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 had 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)

18 52.214-28 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS--SEALED BIDDING  
(OCT 1997)

(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 specific 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)

19 52.214-29 ORDER OF PRECEDENCE--SEALED BIDDING (JAN 1986)

Any inconsistency in this solicitation or contract shall be resolved by giving precedence in the following order: (a) the Schedule (excluding the specifications); (b) representations and other instructions; (c) contract clauses; (d) other documents, exhibits, and attachments; and (e) the specifications.

(End of clause)

20 52.219-8 UTILIZATION OF SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS CONCERNS (JUN 1997)

(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)

21 52.219-14 LIMITATIONS ON SUBCONTRACTING (DEC 1996)

(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)

22 52.222-3 CONVICT LABOR (AUG 1996)

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; and

(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)

23 52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT--OVERTIME  
COMPENSATION (JUL 1995)

(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 mechanic 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)

24 52.222-6 DAVIS-BACON ACT (FEB 1995)

(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 approve 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.

(iv) With respect to helpers, such a classification prevails in the area in which the work is performed.

(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)

25 52.222-7 WITHHOLDING OF FUNDS (FEB 1988)

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)

26 52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)

(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 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)

27 52.222-9 APPRENTICES AND TRAINEES (FEB 1988)

(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 rate) 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)

28 52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

(End of clause)

29 52.222-11 SUBCONTRACTS (LABOR STANDARDS) (FEB 1988)

(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 deliver 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 deliver to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

(End of clause)

30 52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)

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)

31 52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988)

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)

32 52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)

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 of their representatives.

(End of clause)

33 52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)

(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)

34 52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (APR 1984)

(a) The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause 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 for each trade
MINORITY GOALS FOR WA: 6.2% IN PIERCE COUNTY	
GOALS FOR FEMALE PARTICIPATION = 6.9% IN WA	

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

(c) The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the

goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. 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, Executive Order 11246, as amended, and the regulations in 41 CFR 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, Office of Federal Contract Compliance Programs, within 10 working days following 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--

- (1) Name, address, and telephone number of the subcontractor;
- (2) Employer's identification number of the subcontractor;
- (3) Estimated dollar amount of the subcontract;
- (4) Estimated starting and completion dates of the subcontract; and
- (5) Geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is WA STATE/PIERCE COUNTY/TACOMA.

(End of provision)

(R 7-2003.14(d) 1978 SEP)

35 52.222-26 EQUAL OPPORTUNITY (APR 1984)

(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 shall 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 advertisements 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 subcontractor 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)

(R 7-103.18 1978 SEP)

(R 1-12.803-2)

(R 7-607.13 1978 SEP)

36 52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION  
(APR 1984)

(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's 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 Form 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);

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin); and

(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 and 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 the 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 action 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 participant 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) Makes 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)

(R 7-603.60 1978 SEP)

37 52.222-35 AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (APR 1998)

(a) Definitions. 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 consideration will be given to persons outside the Contractor's organization (including any 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 employer 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 that 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)

38 52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)

(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 or 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)

39 52.222-37 EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (APR 1998)

(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 workforce 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 date 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 1st 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)

40 52.223-2 CLEAN AIR AND WATER (APR 1984)

(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 all 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)

(R 7-103.29 1975 OCT)

(R 1-1.2302)

41 52.223-3 HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA  
(JAN 1997)

(a) "Hazardous material," as used in this clause, includes any material defined as hazardous under the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract).

(b) The Offeror must list any hazardous material, as defined in paragraph (a) of this clause, to be delivered under this contract. The hazardous material shall be properly identified and include any applicable identification number, such as National Stock Number or Special Item Number. This information shall also be included on the Material Safety Data Sheet submitted under this contract.

Material Identification No.  
(If none, insert None)

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(c) This list must be updated during performance of the contract whenever the Contractor determines that any other material to be delivered under this contract is hazardous.

(d) The apparently successful Offeror agrees to submit, for each item as required prior to award, a Material Safety Data Sheet, meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313, for all hazardous material identified in paragraph (b) of this clause. Data shall be submitted in accordance with Federal Standard No. 313, whether or not the apparently successful Offeror is the actual manufacturer of these items. Failure to submit the Material Safety Data Sheet prior to award may result in the apparently successful Offeror being considered nonresponsible and ineligible for award.

(e) If, after award, there is a change in the composition of the item(s) or a revision to Federal Standard No. 313, which renders incomplete or inaccurate the data submitted under paragraph (d) of this clause, the Contractor shall promptly notify the Contracting Officer and resubmit the data.

(f) Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.

(g) Nothing contained in this clause shall relieve the Contractor from complying with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

(h) The Government's rights in data furnished under this contract with respect to hazardous material are as follows:

(1) To use, duplicate and disclose any data to which this clause is applicable. The purposes of this right are to--

(i) Apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting, or disposing of hazardous materials;

(ii) Obtain medical treatment for those affected by the material; and

(iii) Have others use, duplicate, and disclose the data for the Government for these purposes.

(2) To use, duplicate, and disclose data furnished under this clause, in accordance with subparagraph (h)(1) of this clause, in precedence over any other clause of this contract providing for rights in data.

(3) The Government is not precluded from using similar or data acquired from other sources.

(End of clause)

42 52.223-6 DRUG-FREE WORKPLACE (JAN 1997)

(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)

## 43 52.223-14 TOXIC CHEMICAL RELEASE REPORTING (OCT 1996)

(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 Inventory 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 filed with EPA);

(4) The facility does not fall within 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 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)

## 44 52.223-7001 HAZARD WARNING LABELS (DEC 1991)

(a) "Hazardous material," as used in this clause, is defined in the Hazardous Material Identification and Material Safety Data clause of this contract.

(b) The Contractor shall label the item package (unit container) of any hazardous material to be delivered under this contract in accordance with

the Hazard Communication Standard (29 CFR 1910.1200 et seq.). The Standard requires that the hazard warning label conform to the requirements of the standard unless the material is otherwise subject to the labelling requirements of one of the following statutes:

- (1) Federal Insecticide, Fungicide and Rodenticide Act;
- (2) Federal Food, Drug and Cosmetics Act;
- (3) Consumer Product Safety Act;
- (4) Federal Hazardous Substances Act; or
- (5) Federal Alcohol Administration Act.

(c) The Offeror shall list which hazardous material listed in the Hazardous Material Identification and Material Safety Data clause of this contract will be labelled in accordance with one of the Acts in paragraphs (b)(1) through (5) of this clause instead of the Hazard Communication Standard. Any hazardous material not listed will be interpreted to mean that a label is required in accordance with the Hazard Communication Standard.

Material (if none, insert "none.")	Act
	_____
	_____

(d) The apparently successful Offeror agrees to submit, before award, a copy of the hazard warning label for all hazardous materials not listed in paragraph (c) of this clause. The Offeror shall submit the label with the Material Safety Data Sheet being furnished under the Hazardous Material Identification and Material Safety Data clause of this contract.

(e) The Contractor shall also comply with MIL-STD-129, Marking for Shipment and Storage (including revisions adopted during the term of this contract).

(End of clause)

45      52.223-7005      HAZARDOUS WASTE LIABILITY (OCT 1992)

(a) Definitions.

As used in this clause--

(1) "Hazardous waste" has the meaning given that term by section 1004(5) of the Solid Waste Disposal Act (42 U.S.C. 6903(5)), except that such term also includes polychlorinated biphenyls (PCB).

(2) "Polychlorinated biphenyls" (PCB) has the meaning given that term under section 6(e) of the Toxic Substances Control Act (15 U.S.C. 2605(e)).

(b) Upon receipt of hazardous waste properly characterized pursuant to applicable laws and regulations, the Contractor agrees that it shall reimburse the Government for any penalties assessed against, all liabilities incurred by, costs incurred by, and damages suffered by, the Government that are caused by--

- (1) The Contractor's breach of any terms of the contract; or
- (2) Any negligent or willful act or omission of the Contractor or employees of the Contractor, in the performance of the contract.

(c) Not later than 30 days after the award date of the contract, the Contractor shall demonstrate the ability to reimburse the Government as provided in paragraph (b) of this clause, by providing evidence to the Contracting Officer that--

(1) The facility has liability insurance meeting the requirements of 40 CFR 264.147; or

(2) The facility meets the financial assurance requirements of 40 CFR 264.147 for sudden and nonsudden accidental occurrences.

(d) This clause does not apply to--

- (1) Performance of remedial action or corrective action under--
  - (i) The Defense Environmental Restoration Program;

- (ii) Other programs or activities of the Department of Defense; or
  - (iii) Authorized State hazardous waste programs;
  - (2) Disposal of hazardous waste when the generation of such waste is incidental to the performance of the contract; or
  - (3) Disposal of ammunition or solid rocket motors.
- (e) The Contractor shall include this clause, including this paragraph (e), in each subcontract under which the subcontractor receives hazardous waste from a defense facility.
- (End of clause)

46 52.225-5 BUY AMERICAN ACT--CONSTRUCTION MATERIALS (JUN 1997)

(a) 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 materials," 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:  
 %%Insert list of applicable accepted materials or indicate "none"  
 NONE

(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 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.

(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 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 contact 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)

47 52.225-11 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (AUG 1998)

(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, 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)

48 52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT  
(AUG 1996)

(a) The Contractor shall report to the Contracting Officer, promptly and in reasonable written detail, each notice or claim of patent or copyright infringement based on the performance of this contract of which the Contractor has knowledge.

(b) In the event of any claim or suit against the Government on account of any alleged patent or copyright infringement arising out of the performance of this contract or out of the use of any supplies furnished or work or services performed under this contract, the Contractor shall furnish to the Government, when requested by the Contracting Officer, all evidence and information in possession of the Contractor pertaining to such suit or claim. Such evidence and information shall be furnished at the expense of the Government except where the Contractor has agreed to indemnify the Government.

(c) The Contractor agrees to include, and require inclusion of, this clause in all subcontracts at any tier for supplies or services (including construction and architect-engineer subcontracts and those for material, supplies, models, samples, or design or testing services) expected to exceed the simplified acquisition threshold at FAR 2.101.

(End of clause)

49 52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)

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)

(R 7-602.16 1964 JUN)

50 52.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)

(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)

51 52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)

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)

52 52.228-12 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (OCT 1995)

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)

53 52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991)

(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 exceeds \$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)

54 52.231-7000 SUPPLEMENTAL COST PRINCIPLES (DEC 1991)

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)

55 52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997)

(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 total amount of 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;

(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 8th day after 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 amounts. 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)

56 52.232-17 INTEREST (JUN 1996)

(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)

57 52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986)

(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 its 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.

(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)

58 52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (JUN 1997)

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 the date of an electronic funds transfer. Definitions of pertinent terms are set forth in section 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 that 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. 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 the 30th day after the date of 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 proper 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 the 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 paragraphs (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 may 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 will 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 from such date 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 paragraph (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 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 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 also shall 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) 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 must be postmarked on or before the 40th day after payment was made, except that--

(1) If the postmark 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 interest penalty, 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 accrued in the absence of these limits, subject to the overall limits on the additional penalty specified in subdivision (a)(6)(iii)(A) of this 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 payments shall be made on the 14TH 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 that 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 that 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 is 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 obligation to pay an interest penalty.

(3) Subcontractor clause flowdown. A clause requiring each contractor 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 the 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 a 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 paragraph (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)

59 52.232-33 MANDATORY INFORMATION FOR ELECTRONIC FUNDS TRANSFER PAYMENT  
(AUG 1996)

(a) Method of payment. Payments by the Government under this contract, including invoice and contract financing payments, may be made by check or electronic funds transfer (EFT) at the option of the Government. If payment is made by EFT, the Government may, at its option, also forward the associated payment information by electronic transfer. As used in this clause, the term "EFT" refers to the funds transfer and may also include the information transfer.

(b) Mandatory submission of Contractor's EFT information.

(1) The Contractor is required, as a condition to any payment under this contract, to provide the Government with the information required to make payment by EFT as described in paragraph (d) of this clause, unless the payment office determines that submission of the information is not required. However, until January 1, 1999, in the event the Contractor certifies in writing to the payment office that the Contractor does not have an account with a financial institution or an authorized payment agent, payment shall be made by other than EFT. For any payments to be made after January 1, 1999, the Contractor shall provide EFT information as described in paragraph (d) of this clause.

(2) If the Contractor provides EFT information applicable to multiple contracts, the Contractor shall specifically state the applicability of this EFT information in terms acceptable to the payment office.

(c) Contractor's EFT information. Prior to submission of the first request for payment (whether for invoice or contract financing payment) under this contract, the Contractor shall provide the information required to make contract payment by EFT, as described in paragraph (d) of this clause, directly to the Government payment office named in this contract. If more than one payment office is named for the contract, the Contractor shall provide a separate notice to each office. In the event that the EFT information changes, the Contractor shall be responsible for providing the changed information to the designated payment office(s).

(d) Required EFT information. The Government may make payment by EFT through either an Automated Clearing House (ACH) subject to the banking laws of the United States or the Federal Reserve Wire Transfer System at the Government's option. The Contractor shall provide the following information for both methods in a form acceptable to the designated payment office. The Contractor may supply this data for this or multiple contracts (see paragraph (b) of this clause).

- (1) The contract number to which this notice applies.
- (2) The Contractor's name and remittance address, as stated in the contract, and account number at the Contractor's financial agent.
- (3) The signature (manual or electronic, as appropriate), title, and telephone number of the Contractor official authorized to provide this information.
- (4) For ACH payments only:
  - (i) Name, address, and 9-digit Routing Transit Number of the Contractor's financial agent.
  - (ii) Contractor's account number and the type of account (checking, saving, or lockbox).
- (5) For Federal Reserve Wire Transfer System payments only:
  - (i) Name, address, telegraphic abbreviation, and the 9-digit Routing Transit Number for the Contractor's financial agent.
  - (ii) If the Contractor's financial agent is not directly on-line to the Federal Reserve Wire Transfer System and, therefore, not the receiver of the wire transfer payment, the Contractor shall also provide the name, address, and 9-digit Routing Transit Number of the correspondent financial institution receiving the wire transfer payment.
- (e) Suspension of payment.
  - (1) Notwithstanding the provisions of any other clause of this contract, the Government is not required to make any payment under this contract until after receipt, by the designated payment office, of the correct EFT payment information from the Contractor or a certificate submitted in accordance with paragraph (b) of this clause. Until receipt of the correct EFT information, any invoice or contract financing request shall be deemed not to be a valid invoice or contract financing request as defined in the Prompt Payment clause of this contract.
  - (2) If the EFT information changes after submission of correct EFT information, the Government shall begin using the changed EFT information no later than the 30th day after its receipt to the extent payment is made by EFT. However, the Contractor may request that no further payments be made until the changed EFT information is implemented by the payment office. If such suspension would result in a late payment under the Prompt Payment clause of this contract, the Contractor's request for suspension shall extend the due date for payment by the number of days of the suspension.
- (f) Contractor EFT arrangements. The Contractor shall designate a single financial agent capable of receiving and processing the electronic funds transfer using the EFT methods described in paragraph (d) of this clause. The Contractor shall pay all fees and charges for receipt and processing of transfers.
- (g) Liability for uncompleted or erroneous transfers.
  - (1) If an uncompleted or erroneous transfer occurs because the Government failed to use the Contractor-provided 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 Contractor-provided EFT information was incorrect at the time 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 retains the right to either make payment by mail or suspend the payment in accordance with paragraph (e) of this clause.
- (h) EFT and prompt payment.
  - (1) A payment shall be deemed to have been made in a timely manner in accordance with the Prompt Payment clause of this contract if, in the EFT

payment transaction instruction given 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.

(2) When payment cannot be made by EFT because of incorrect EFT information provided by the Contractor, no interest penalty is due after the date of the uncompleted or erroneous payment transaction, provided that notice of the defective EFT information is issued to the Contractor within 7 days after the Government is notified of the defective EFT information.

(i) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the Assignment of Claims clause of this contract, the assignee shall provide the assignee EFT information required by paragraph (d) of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information which 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) Payment office discretion. If the Contractor does not wish to receive payment by EFT methods for one or more payments, the Contractor may submit a request to the designated payment office to refrain from requiring EFT information or using the EFT payment method. The decision to grant the request is solely that of the Government.

(k) Change of EFT information by financial agent. The Contractor agrees that the Contractor's financial agent may notify the Government of a change to the routing transit number, Contractor account number, or account type. The Government shall use the changed data in accordance with paragraph (e)(2) of this clause. The Contractor agrees that the information provided by the agent is deemed to be correct information as if it were provided by the Contractor. The Contractor agrees that the agent's notice of changed EFT data is deemed to be a request by the Contractor in accordance with paragraph (e)(2) that no further payments be made until the changed EFT information is implemented by the payment office.

(End of clause)

60 52.232-7009 PAYMENT BY ELECTRONIC FUNDS TRANSFER (CCR) (JUN 1998)

(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) of (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 Contractor'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 makes 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)

61 52.233-1 I DISPUTES (OCT 1995)--ALTERNATE I (DEC 1991)

(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 certifications, as defined in (FAR) 48 CFR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claims 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 or relating to the contract, and comply with any decision of the Contracting Officer.

(End of clause)

62 52.233-3 PROTEST AFTER AWARD (AUG 1996)

(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 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)

63 52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

(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 (a) above 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)

64 52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)

(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 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 which 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)

65 52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)

(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 full 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 charges prepaid. Machinery, equipment, material, and articles that do 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)

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66 52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)

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 work site a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

(End of clause)

## 67 52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)

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)

## 68 52.236-8 OTHER CONTRACTS (APR 1984)

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)

## 69 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)

(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)

## 70 52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)

(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)

71 52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)

(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)

72 52.236-12 CLEANING UP (APR 1984)

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)

73 52.236-13 ACCIDENT PREVENTION (NOV 1991)

(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.

(End of clause)

74 52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)

(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 payments 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 deliver 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)

75 52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)

(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 the 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)

76 52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995)

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)

77 52.236-7000 MODIFICATION PROPOSALS--PRICE BREAKDOWN (DEC 1991)

(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 an 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)

78 52.242-13 BANKRUPTCY (JUL 1995)

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)

79 52.242-14 SUSPENSION OF WORK (APR 1984)

(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)

80 52.243-4 CHANGES (AUG 1987)

(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 of 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 the 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)

81 52.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)

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)

82 52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS AND COMMERCIAL COMPONENTS (APR 1998)

(a) Definition.

"Commercial item," as used in this clause, has the meaning contained in the clause at 52.202-1, Definitions.

"Subcontract," as used in this clause, includes a transfer of commercial items between divisions, subsidiaries, or affiliates of the Contractor or subcontractor at any tier.

(b) To the maximum extent practicable, the Contractor shall incorporate, and require its subcontractors at all tiers to incorporate, commercial items or nondevelopmental items as components of items to be supplied under this contract.

(c) Notwithstanding any other clause of this contract, the Contractor is not required to include any FAR provision or clause, other than those listed below to the extent they are applicable and as may be required to establish the reasonableness of prices under Part 15, in a subcontract at any tier for commercial items or commercial components:

- (1) 52.222-26, Equal Opportunity (E.O. 11246);
- (2) 52.222-35, Affirmative Action for Disabled Veterans and Veterans of the Vietnam Era (38 U.S.C. 4212(a));
- (3) 52.222-36, Affirmative Action for Handicapped Workers (29 U.S.C. 793); and
- (4) 52.247-64, Preference for Privately Owned U.S.-Flagged Commercial Vessels (46 U.S.C. 1241) (flow down not required for subcontracts awarded beginning May 1, 1996).

(d) The Contractor shall include the terms of this clause, including this paragraph (d), in subcontracts awarded under this contract.

(End of clause)

83 52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)

(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 completed 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)

84 52.248-3 VALUE ENGINEERING--CONSTRUCTION (MAR 1989)

(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 prediction 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 decision. 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) Collateral savings. If a VECP is accepted, the instant contract amount shall be increased by 20 percent of any projected collateral savings determined to be realized in a typical year of use after subtracting any Government costs not previously offset. However, the Contractor's share of collateral savings shall not exceed (1) the contract's firm-fixed-price or estimated cost, at the time the VECP is accepted, or (2) \$100,000, whichever is greater. The Contracting Officer shall be the sole determiner of the amount of collateral savings, and that amount shall not be subject to the Disputes clause or otherwise subject to litigation under 41 U.S.C. 601-613.

(h) Subcontracts. The Contractor shall include an appropriate value engineering clause in any subcontract of \$50,000 or more and 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.

(i) 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)

85 52.248-7000 PREPARATION OF VALUE ENGINEERING CHANGE PROPOSALS (MAY 1994)

Prepare value engineering change proposals, for submission pursuant to the value engineering clause of this contract, in the format prescribed by the version of MIL-STD-973 in effect on the date of contract award.  
(End of clause)

86 52.249-2 I TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE)  
(SEP 1996)-- ALTERNATE I (SEP 1996)

(a) The Government may terminate performance of work under this contract in whole or, from time to time, 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 of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and deliver 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 or remaining 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 Contracting Officer fail to agree on the whole amount to be paid the Contractor 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 no 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)

87 52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)

(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)

88 52.249-5000 BASIS FOR SETTLEMENT OF PROPOSALS

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 unallowable 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.

(End of Statement)

89 52.252-4 ALTERATIONS IN CONTRACT (APR 1984)

Portions of this contract are altered as follows:

(End of clause)

(R 7-105.1(a) 1949 JUL)

90 52.253-1 COMPUTER GENERATED FORMS (JAN 1991)

(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 there is no change to the name, content, or sequence of the data elements on the form, and provided the form carries the Standard or Optional Form number and edition date.

(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 date.

(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)

91 52.228-11 PLEDGES OF ASSETS (FEB 1992)

(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 owners; 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)

END OF SECTION 00700

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## SPECIAL CLAUSES

SC-1. COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984) (FAR 52.211-10).

The Contractor shall be required to (a) commence work under this Contract within 10 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 400 calendar days after date of receipt by Contractor of notice to proceed. The time stated for completion shall include final cleanup of the premises. See Section 01005 SITE SPECIFIC SUPPLEMENTARY REQUIREMENTS for CONSTRUCTION PHASING.

SC-1.1 DELETED.

SC-2. LIQUIDATED DAMAGES - CONSTRUCTION (APR 1984) (FAR 52.211-12)

(a) 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 \$850.00 for each day of delay.

(b) 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.

(c) 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.

SC-3 AND SC-4 DELETED.

SC-5. INSURANCE - WORK ON A GOVERNMENT INSTALLATION (SEP 1989) (FAR 52.228-5)

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance period of this Contract at least the kinds and minimum amounts of insurance required in the Insurance Liability Schedule or elsewhere in the Contract.

(b) 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.

(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.

(d) Insurance Liability Schedule (FAR 28.307-2)

(1) Workers' compensation and employer's liability. Contractors are required to comply with applicable Federal and State workers' compensation and occupational disease statutes. If occupational diseases are not compensable under those statutes, they shall be covered under the employer's liability section of the insurance policy, except when Contract operations are so commingled with a Contractor's commercial operation that it would not be practical to require this coverage. Employer's liability coverage of at least \$100,000 shall be required, except in states with exclusive or monopolistic funds that do not permit workers' compensation to be written by private carriers.

(2) General Liability.

(a) The Contracting Officer shall require bodily injury liability insurance coverage written on the comprehensive form of policy of at least \$500,000 per occurrence.

(b) Property damage liability insurance shall be required only in special circumstances as determined by the agency.

(3) Automobile liability. The Contracting Officer shall require automobile liability insurance written on the comprehensive form of policy. The policy shall provide for bodily injury and property damage liability covering the operation of all automobiles used in connection with performing the Contract. Policies covering automobiles operated in the United States shall provide coverage of at least \$200,000 per person and \$500,000 per occurrence for bodily injury and \$20,000 per occurrence for property damage. The amount of liability coverage on other policies shall be commensurate with any legal requirements of the locality and sufficient to meet normal and customary claims.

(4) Aircraft public and passenger liability. When aircraft are used in connection with performing the Contract, the Contracting Officer shall require aircraft public and passenger liability insurance. Coverage shall be at least \$200,000 per person and \$500,000 per occurrence for bodily injury, other than passenger liability, and \$200,000 per occurrence for property damage. Coverage for passenger liability bodily injury shall be at least \$200,000 multiplied by the number of seats or passengers, whichever is greater.

(5) Environmental Liability If this contract includes the transport, treatment, storage, or disposal of hazardous material waste the following coverage is required.

The Contractor shall ensure the transporter and disposal facility have liability insurance in effect for claims arising out of the death or bodily injury and property damage from hazardous material/waste transport, treatment, storage and disposal, including vehicle liability and legal defense costs in the amount of \$1,000,000.00 as evidenced by a certificate of insurance for General, Automobile, and Environmental Liability Coverage. Proof of this insurance shall be provided to the Contracting Officer.

SC-6. DELETED.

SC-7. PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984) (FAR 52.236-1): The Contractor shall perform on the site, and with its own organization, work equivalent to at least fifteen (15%) percent of the total amount of work to be performed under the Contract. The 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.

SC-8. PHYSICAL DATA (APR 1984) (FAR 52.236-4): Data and information furnished or referred to below is for the Contractor's information. The Government will not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(a) Physical Conditions: The indications of physical conditions on the drawings and in the specifications are the result of site investigations by test holes shown on the drawings.

(b) Weather Conditions: Each bidder shall be satisfied before submitting his bid as to the hazards likely to arise from weather conditions. Complete weather records and reports may be obtained from any National Weather Service Office.

(c) Transportation Facilities: Each bidder, before submitting his bid, shall make an investigation of the conditions of existing public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress at the jobsite. The unavailability of transportation facilities or limitations thereon shall not become a basis for claims for damages or extension of time for completion of the work.

SC-9. DELETED.

SC-10. 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 its 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.

SC-11 THROUGH SC-13. DELETED.

SC-14. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE (MAR 1995)- (EFARS 52.231-5000)

(a) This clause does not apply to terminations. See 52.249-5000, Basis for Settlement of Proposals and FAR Part 49.

(b) 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 for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region VIII. 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 retroactive pricing, the schedule in effect at the time the work was performed shall apply.

(c) Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

(d) When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the contracting officer shall request the contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet.

(e) Copies of EP1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule" Volume 4 (Montana) and Volume 8 (Washington, Oregon and Idaho) are available from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954, phone (202) 512-1800 and fax (202) 512-2250, OR from the Government Bookstore in the Jackson Federal Building, Seattle, WA, phone (206) 553-4279. The cost is \$28.00 for each volume. Use the following stock numbers when ordering schedules:

S/N 008-022-00300-2	Volume 4
S/N 008-022-00304-5	Volume 8

SC-15. PAYMENT FOR MATERIALS DELIVERED OFF-SITE (MAR 1995)-(EFARS 52.232-5000)

(a) Pursuant to FAR clause 52.232-5, Payments Under Fixed Priced Construction Contracts, materials delivered to the contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the General Provisions are fulfilled. Payment for items delivered to locations other than the work site will be limited to: (1) materials required by the technical provisions; or (3) materials that have been fabricated to the point where they are identifiable to an item of work required under this contract.

(b) Such payment will be made only after receipt of paid or receipted invoices or invoices with canceled check showing title to the items in the prime contractor and including the value of material and labor incorporated into the item. In addition to petroleum products, payment for materials delivered off-site is limited to the following items: Any other construction material stored offsite may be considered in determining the amount of a progress payment.

SC-16 AND SC-17. DELETED.

SC-18. CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (DEC 1991)(DOD FAR SUPP 252.236-7001)

(a) The Government--

Will provide the Contractor, without charge, five sets of contract drawings and one set of specifications in electronic format on a compact disk. The Government will not give the Contractor any hard

copy paper drawings and specifications for any contract resulting from this solicitation.

(b) 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 this paragraph (b).

(c) Large scale drawings shall, in general, govern small scale drawings. Figures marked on drawings shall, in general, be followed in preference to scale measurements.

(d) 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.

(e) The work shall conform to the specifications and the contract drawings identified on the index of drawings at the end of this section.

SC-19 Through SC-21 DELETED.

SC-22. EPA ENERGY STAR: The Government requires that certain equipment be Energy Star compliant. Initially, the sole Energy Star requirement shall be the self certification by the bidder that the specified equipment is Energy Star compliant. Within 3 months of the availability of an EPA sanctioned test for Energy Star compliance, the Contractor shall submit all equipment upgrades and additions for testing and provide proof of compliance to the Government upon completion of testing. Testing shall be at the Contractor's expense.

SC-23. 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 Year 2000 compliance requirement.

(2) Indicate whether each component is currently Year 2000 compliant or requires an upgrade for compliance prior to Government acceptance.

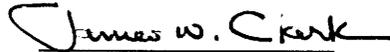
# DESIGN AUTHENTICATION

Centralized Fuel Station  
Yakima Training Center, Washington

Signatures affixed below indicate the drawings and specifications included in this solicitation were prepared, reviewed and certified in accordance with Department of Army Engineer Regulation.



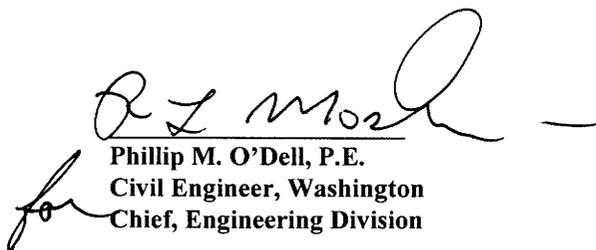
Lloyd G. Darko, P.E.  
Civil Engineer, Washington  
Acting Chief, Cost Engineering  
and Technical Support



James W. Clark  
Project Manager



Rick L. Moshier, P.E.  
Mechanical Engineer, Washington  
Chief, Design Branch



Phillip M. O'Dell, P.E.  
Civil Engineer, Washington  
Chief, Engineering Division

This project was designed by the U.S. Army Corps of Engineers, Seattle District. The initials and/or signatures and registration designations of individuals appearing on these project documents are within the scope of their employment as required by ER 1110-1-8152, ENGINEERING AND DESIGN PROFESSIONAL REGISTRATION.

FILE NUMBER	SHEET NUMBER	PLATE NUMBER	TITLE	REV. NO.	DATE
			CENTRALIZED FUEL STATION, YAKIMA TRAINING CENTER, WASHINGTON (PN 43091)		
			<u>GENERAL</u>		
24s/123-10-01	1	G-1	Cover Sheet and Drawing Index		<u>98SEP18</u>
	2	G-2	Drawing Index and Abbreviations		<u>98SEP18</u>
			<u>GEOTECHNICAL</u>		
	3	GT-1	Exploration Logs		<u>98SEP18</u>
	4	GT-2	Exploration Logs		<u>98SEP18</u>
	5	GT-3	Locations of Explorations		<u>98SEP18</u>
			<u>CIVIL</u>		
	6	C-1	Legend and Abbreviations		<u>98SEP18</u>
	7	C-2	Site Plan		<u>98SEP18</u>
	8	C-3	Grading Plan		<u>98SEP18</u>
	9	C-4	Utility Plan		<u>98SEP18</u>
	10	C-5	Concrete Joint Layout Plan		<u>98SEP18</u>
	11	C-6	Miscellaneous Details 1		<u>98SEP18</u>
	12	C-7	Miscellaneous Details 2		<u>98SEP18</u>
	13	C-8	Pavement Sections and Details		<u>98SEP18</u>
	14	C-9	Concrete Pavement Details		<u>98SEP18</u>
	15	C-10	Miscellaneous Sections and Details		<u>98SEP18</u>
	16	C-11	Oil/Water Separator Site/ Plan and Elevation	<u>A</u>	<u>98DEC29</u>
	17	C-12	Fencing Details		<u>98SEP18</u>
			<u>ARCHITECTURAL</u>		
	18	A-1	Floor Plan, Bldg Section/ Bldg Elevation & Schedules		<u>98SEP18</u>
	19	A-2	Signage		<u>98SEP18</u>
			<u>STRUCTURAL</u>		<u>98SEP18</u>
	20	S-1	General Notes		<u>98SEP18</u>

FILE NUMBER	SHEET NUMBER	PLATE NUMBER	TITLE	REV. NO.	DATE
24s/123-10-01	21	S-2	Plan		<u>98SEP18</u>
	22	S-3	Section & Details I	<u>A</u>	<u>98DEC29</u>
	23	S-4	Sections & Details II		<u>98SEP18</u>
	24	S-5	Ringwall Foundation Plan/ Sections and Details		<u>98SEP18</u>
	25	S-6	Track Loading Foundation Details		<u>98SEP18</u>
	26	S-7	Miscellaneous Foundation Details	<u>A</u>	<u>98DEC29</u>
	27	S-8	Tank Procurement Drawing		<u>98SEP18</u>
			<u>MECHANICAL</u>		
	28	M-1	Schedules, Legend & Abbreviations		<u>98SEP18</u>
	29	M-2	Piping Schematic I	<u>A</u>	<u>98DEC29</u>
	30	M-3	Piping Schematic II		<u>98SEP18</u>
	31	M-4	Sequence of Operation		<u>98SEP18</u>
	32	M-5	Piping Profiles I		<u>98SEP18</u>
	33	M-6	Piping Profiles II		<u>98SEP18</u>
	34	M-7	Piping Profiles III		<u>98SEP18</u>
	35	M-8	Piping Plan I		<u>98SEP18</u>
	36	M-9	Piping Plan II		<u>98SEP18</u>
	37	M-10	Piping Plan III & IV		<u>98SEP18</u>
	38	M-11	Piping Plan V & VI		<u>98SEP18</u>
	39	M-12	Piping Plan VII & VIII		<u>98SEP18</u>
	40	M-13	Attendant Building Plan & Details		<u>98SEP18</u>
	41	M-14	Miscellaneous Details I		<u>98SEP18</u>
	42	M-15	Miscellaneous Details II		<u>98SEP18</u>
	43	M-16	Miscellaneous Details III		<u>98SEP18</u>
	44	M-17	Tank Appurtenance Plan		<u>98SEP18</u>
	45	M-18	Tank Foundation Leak Detection		<u>98SEP18</u>
	46	M-19	Tank Appurtenances & Fittings I		<u>98SEP18</u>

FILE NUMBER	SHEET NUMBER	PLATE NUMBER	TITLE	REV. NO.	DATE
24s/123-10-01	47	M-20	Tank Appurtenances & Fittings II		<u>98SEP18</u>
	48	M-21	Tank Appurtenances & Fittings III		<u>98SEP18</u>
	49	M-22	Water Draw-Off & Miscellaneous Details		<u>98SEP18</u>
			<u>ELECTRICAL</u>		<u>98SEP18</u>
	50	E-1	Symbols & Schedules		<u>98SEP18</u>
	51	E-2	Site Plan, Power		<u>98SEP18</u>
	52	E-3	Attendant Building		<u>98SEP18</u>
	53	E-4	Site Plan, Communications		<u>98SEP18</u>
	54	E-5	One-Lines		<u>98SEP18</u>
	55	E-6	Details I		<u>98SEP18</u>
	56	E-7	Details II		<u>98SEP18</u>
	57	E-8	Details III		<u>98SEP18</u>
	58	E-9	Details IV		<u>98SEP18</u>
	59	E-10	Details V		<u>98SEP18</u>
	60	E-11	Lightning Protection & Grounding		<u>98SEP18</u>
	61	E-12	Cathodic Protection		<u>98SEP18</u>

MODIFICATIONS TO DRAWINGS BY NOTATION

Sheet 7, PL. C-2: Revise Site Plan as shown on Sketch 1, attached at the end of this Section.

Sheet 8, PL. C-3: Revise FG elevations as shown on Sketch 2, attached at the end of this Section.

Sheet 9, PL. C-4: Revise Utility Plan as shown on Sketch 3, attached at the end of this Section.

Sheet 12, PL. C-7: Revise Catch Basin detail and Dry Barrel Fire Hydrant Detail as shown on Sketch 4 and Sketch 5, attached at the end of this Section.

Sheet 15, PL. C-10: Revise Odd Shaped Panel Reinforcement detail as shown on Sketch 6, attached at the end of this Section.

Sheet 17, PL. C-12: Revise Oil/Water Separator Plan and Elevation as shown on Sketch 7, attached at the end of this Section.

Sheet 18, PL. C-13: Revise Chain Link Fence detail as shown on Sketch 8, attached at the end of this Section.

Sheet 27, PL. S-7: Add "Note 2. Precast concrete pipe trench shall have fuel resistant gaskets. Seal gaskets for fuel resistance per manufacturer's recommendations."

Sheet 28, PL. S-8, ELEVATION: Revise the tank height dimension from 6600mm to 7200mm.

Sheet 31, PL. M-2: Revise AIR ELIMINATION VESSEL SCHEDULE as shown on Sketch 9, attached at the end of this Section.

Sheet 32, PL. M-3, Bulk Fuel Receiving & Issuing Island: (1) Change the isolation valves at the inlet and outlet to the air eliminators from butterfly to full port ball valves (24 places). (2) Change the valves shown at the truck unloading connections from butterfly type to full port ball valves (4 places)

Sheet 33, PL. M-4:

a. Zone E4, Revise loading valve note to read "Loading Valve, Max Pressure Reducing Range 13,8-68.9kPa (Typ)".

b. Zone 2E, Revise piping sizes downstream of meters M-12, M-13 and M-14 from 50mm to 65mm

Sheet 40, PL. M-11, Piping Plan IV: Add note as follows, "Locate Automatic Fuel Management Unit (FMU) on the Tracked Vehicle Refuel Control Pad in accordance with Specification Section 13410."

Sheet 41, PL. M-12:

a. Piping Plan V: Add two notes as follows, "1. Locate Automatic Fuel Management Unit (FMU) on the Bulk Fuel Issuing and Receiving Island in accordance with Specification Section 13410." "2. Reducers are required at two of the air elimination vessels (See Air Elimination Vessel Schedule, Plate M-2)."

b. Piping Plan VI: Add note as follows, "Locate Automatic Fuel Management Unit (FMU) on the Bulk Fuel Issuing Island in accordance with Specification Section 13410."

Sheet 42, PL. M-13, Zone B6: Route the 36MM drain pipe that terminates at the product recovery tank, through a 200mm diameter ductile iron pipe sleeve. Seal connecting sleeve between the concrete trench and the product recovery tank.

Sheet 46, PL. M-17, Tracked Vehicle Fill Stand-Plan: Delete the two 76mm plug valves shown inside the fuel dispensing coffin.

Sheet 47, PL. M-18:

a. TYPICAL TANK ELEVATION: Change the vertical 6.5M dimension to 6.6M

b. SHELL PLATES THICKNESS & WELDING DETAILS: Change the 4.75M inner radius dimension to 4.55M. Change the vertical 8.9M dimension to 7.2M.

Sheet 48, PL. M-19, RING BEAM PLAN: Delete the 8.5 M and 8.0 M dimensions and add "See Plate S-5" (2 places).

Sheet 49, PL. M-20, TABLE 1: Change the Distance From Tank Bottom from 7720mm to 6500mm for Tanks 1, 2 and 3.

Sheet 50, PL. E-5, Zone G5: Change 13,800 to 12,470.

Sheet 55, Plate E-2: Revise Power Site Plan as shown on Sketches 10, 11, 12, 13 and 14, attached at the end of this Section.

Sheet 56, PL. E-3: Revise Power and Auxiliary Plan as shown on Sketch 16, attached at the end of this Section.

Sheet 57, PL. E-4:

a. Revise the Communications Site Plan as shown on Sketch 17, attached at the end of this Section.

b. Revise notes 1, 2, 3 and 5, and add note 6 as shown on Sketch 17, attached at the end of this Section.

Sheet 58, PL. E-5:

a. Revise Panel MPD as shown on Sketch 18, attached at the end of this Section.

b. Revise Power One-Line diagram as shown on Sketch 19, attached at the end of this Section.

Sheet 61, PL. E-8, Add the following notes:

"2. 6" (152.4 mm) HORIZONTAL SPACING SHALL BE MAINTAINED BETWEEN COMMUNICATION DUCTS AND POWER (60 Hz) DUCTS. 2" HORIZONTAL SPACING IS ACCEPTABLE FOR DUCTS OF CONTAINING COMMUNICATIONS OR POWER.

3. A MINIMUM OF ONE SPARE DUCT OF EQUAL SIZE AS OCCUPIED DUCT SHALL BE PROVIDED. SPARE DUCT SHALL BE LOCATED ABOVE THE OCCUPIED DUCT, UNLESS ONLY ONE OCCUPIED DUCT IS PROVIDED IN TRENCH.

4. WHERE INNERDUCT IS INSTALLED, SPARE CONDUIT IS NOT REQUIRED TO HAVE INNERDUCT."

Sheet 63, PL. E-10, detail AUTOMATIC FUEL MONITORING SYSTEM (AFMS), Add the following General Note:

"3. NOT ALL ISLANDS REQUIRE AFMS, NOR WILL ALL ISLANDS OR AFMS INSTALLATIONS APPEAR AS SHOWN. SEE PLATE E-2, SITE PLAN, FOR EXACT LOCATION."

Sheet 7, PL. C-2, Add the following note:

"7. NO GROUND BREAKING OR EARTH MOVING WORK SHALL BE PERFORMED UNTIL THE 48 FIBER, FIBER OPTIC (FO) CABLE BETWEEN DIAL CENTRAL OFFICE (DCO) AND RANGE CONTROL HAS BEEN INSTALLED, IS OPERATIONAL, AND HAS BEEN ACCEPTED BY THE GOVERNMENT."

STANDARD DETAILS BOUND IN THE SPECIFICATIONS

<u>DRAWING NUMBER</u>	<u>SHEET NUMBER</u>	<u>TITLE</u>	<u>DATE</u>
<u>SECTION 01501 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS</u>			
	1	Hard Hat Sign	10SEP90
	1 & 2	U.S. Army Project Sign	84JUN20
<u>SECTION 16375 - ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND</u>			
40-06-04	52	Roadway Lighting Fixture	91FEB
	60	High Intensity Disch. Floodlight	91FEB
<u>SECTION 16415 - Electrical Work, Interior</u>			
40-06-04	15	Incandescent Fixtures for Wet Locations	91FEB
	25	Ceiling Mounted Fluorescent Fixture	91FEB

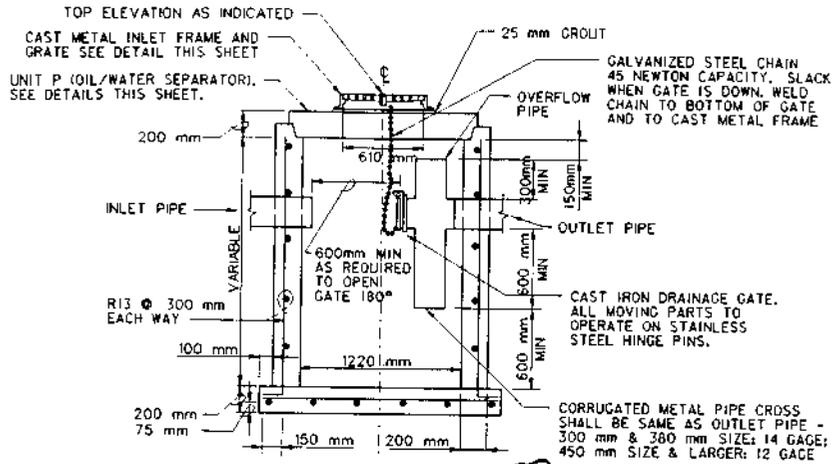
~~END OF SECTION~~

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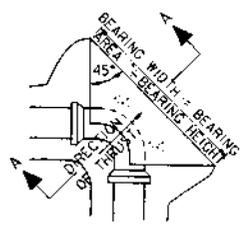
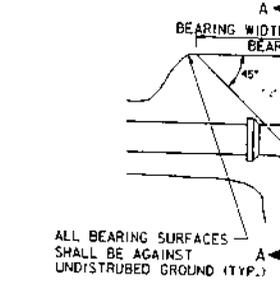




**CATCH BASIN (TYPICAL)  
WITH OIL/WATER SEPARATOR**

NOT TO SCALE

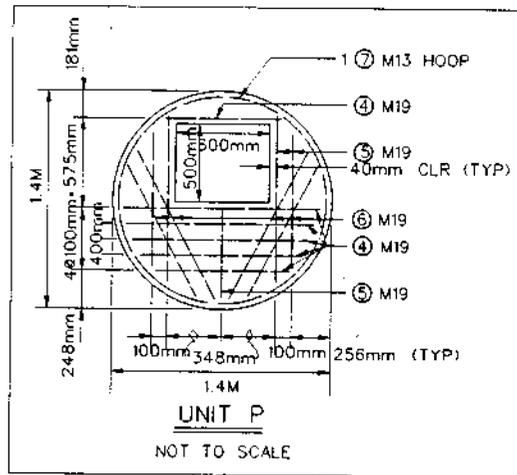
- NOTES:
1. WALLS MAY BE OF MATERIALS OTHER THAN CAST-IN-PLACE CONCRETE. SEE SPECIFICATIONS.
  2. CAST METAL INLET FRAME AND GRATE SHALL BE SECURELY INSTALLED IN A BED OF CEMENT MORTAR.
  3. COVER SLAB AND CAST METAL INLET FRAME AND GRATE SHALL BE OFFSET SO THAT CLEANOUT IS VISIBLE FROM TOP AND SO THAT SPACE BENEATH OPENING IS CLEAR OF CLEANOUT GATE AND OTHER APPURTENANCES.
  4. ALL STEEL PARTS AND SURFACES SHALL BE GALVANIZED AND BITUMINOUS COATED AFTER FABRICATION.



**ELBOW**

PIPE SIZE	TEES AND DEAD ENDS	90° ELBOW
150 mm	0.37	0.5

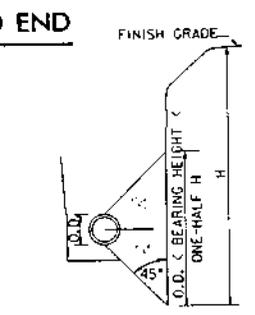
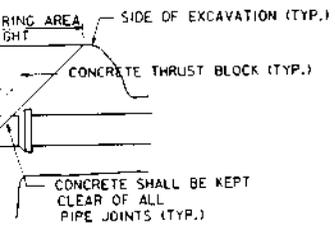
**TYPICAL THRUST**



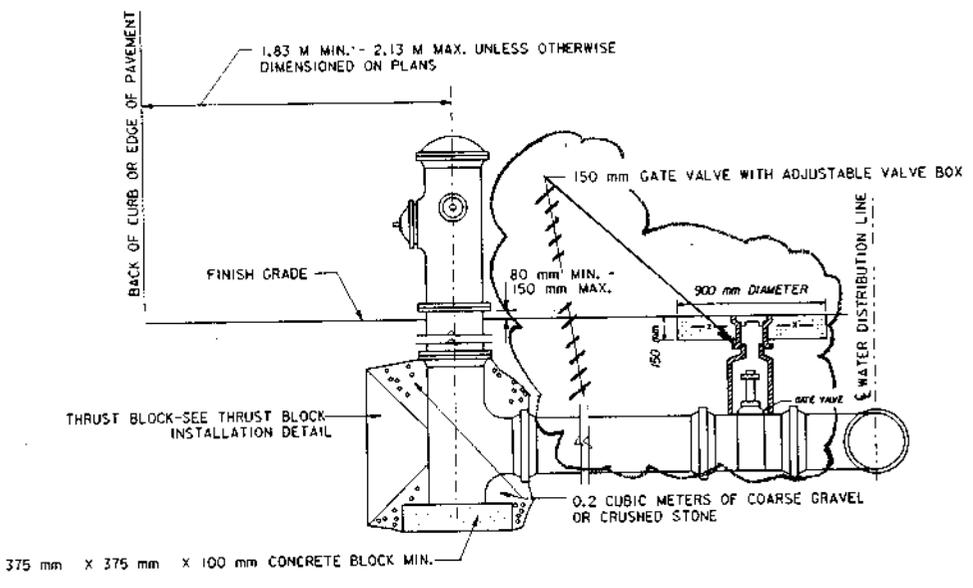
BAR LIST						BENDING DIAGRAM	
ALL DIMENSIONS ARE OUT TO OUT							
MARK	LOCATION	NO	SIZE	LENGTH			
1	BOTTOM BASE SLAB, SIDE WALL	8	3	VARIES	4 EA @ 2225 mm & 2000 mm		
2	TOP BASE SLAB	8	3	VARIES	STR 4 EA @ 1335 mm @ 1130 mm		
3	BASE SIDE WALL	2	3	4.54M			
4	UNIT P BOTTOM-LONG	6	6	VARIES	L-2 @ 1.425M EA @ 1.375M, 1.275M, 1.125M		
5	UNIT P BOTTOM-TRANS	5	6	VARIES	L-2 EA @ 1.25M & 1.1M, 1 @ 825mm		
6	UNIT P BOTTOM-DIAG	4	6	VARIES	STR 2 EA @ 1.125M & 950mm		
7	UNIT P TOP	1	4	4.54M			

SHT. 12, PL. C-7  
SKETCH 4

R0005



SECTION A-A



**DRY BARREL FIRE HYDRANT DETAIL**  
**TYPICAL FIRE HYDRANT SETTING**

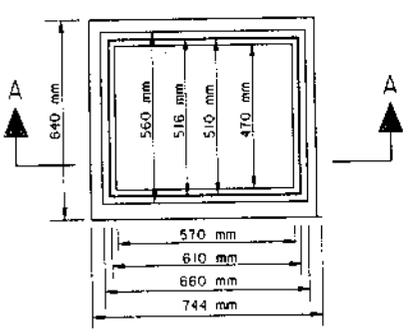
NOT TO SCALE

EACH DIRECTION  
SQUARE METERS

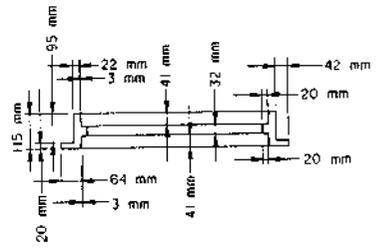
45° ELBOWS	22.5° ELBOWS	1-25° ELBOWS
0.28	0.2	0.2

**FRAME INSTALLATION**

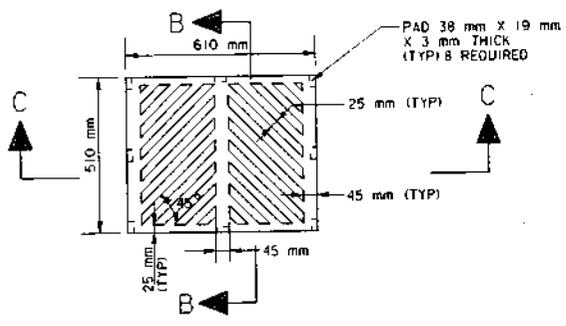
SCALE



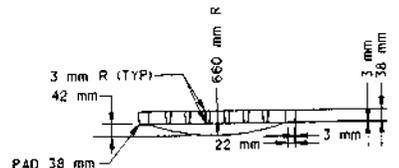
FRAME PLAN



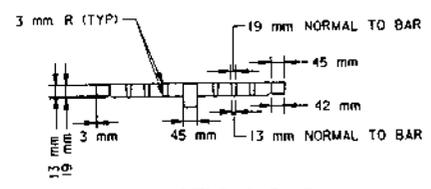
SECTION A-A



GRATE PLAN



SECTION B-B



SECTION C-C

**CAST METAL INLET FRAME AND GRATE**

NOTE: MINIMUM WEIGHT OF FRAME AND GRATE IS 130 KG  
NOT TO SCALE

SHEET 12, PLG-7

SKETCH 5

R0005

00800-1B

Date:	98SEP8
File #:	245/123-10-01
Designed by:	SRIDGE
Drawn by:	SRIDGE
Checked by:	SRIDGE

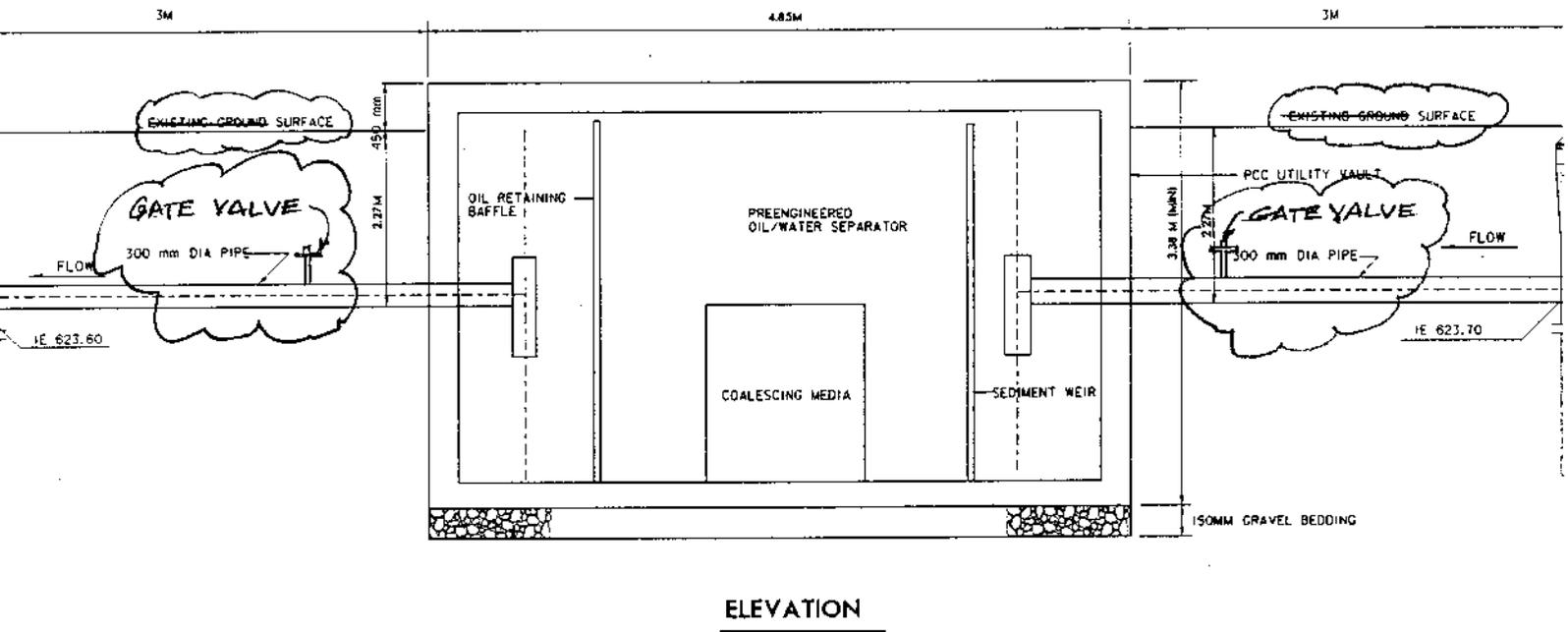
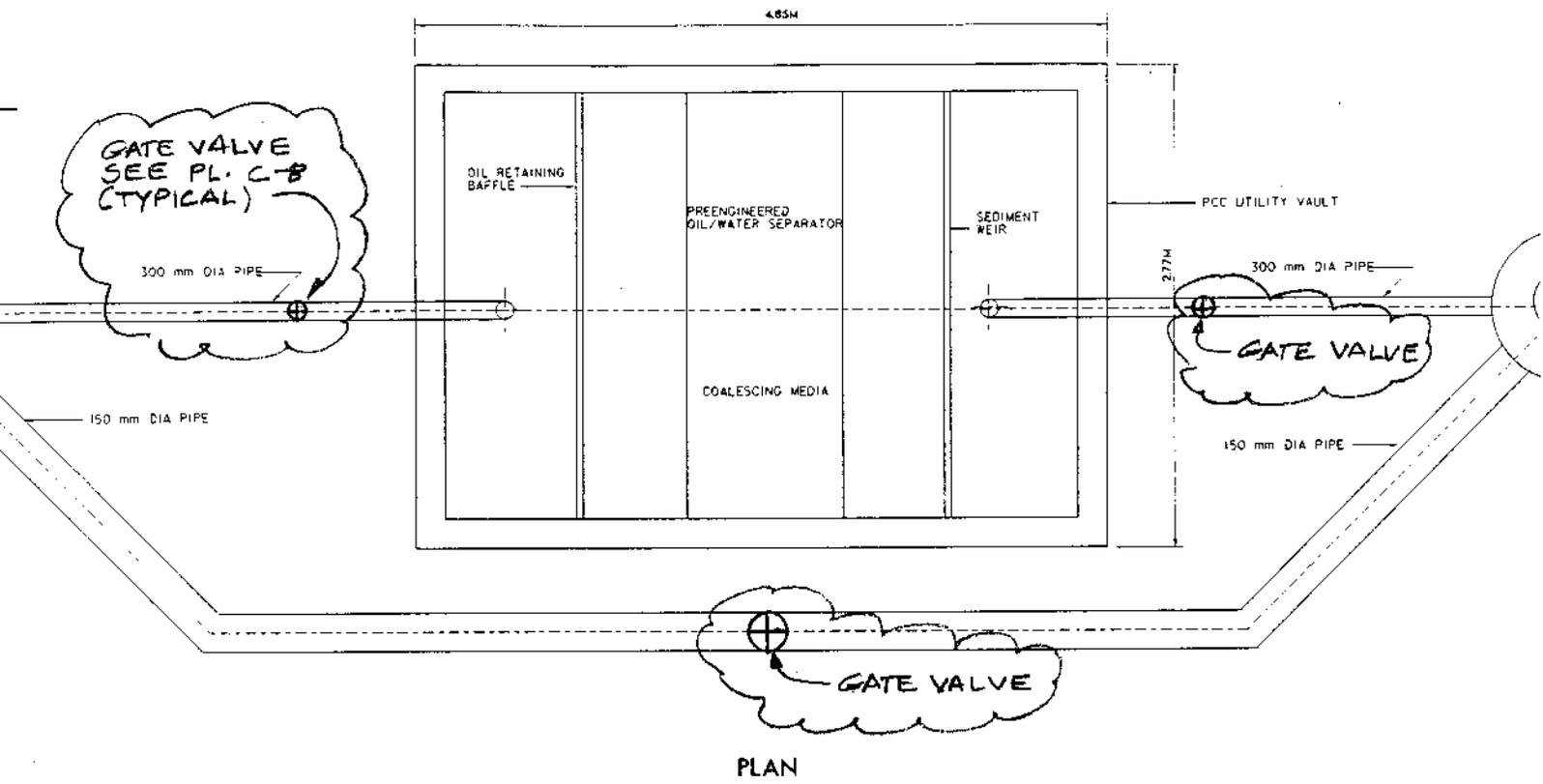
U.S. ARMY ENGINEER DISTRICT, SEATTLE  
CORPS OF ENGINEERS  
SEATTLE, WASHINGTON  
Prepared by:

CENTRALIZED FUEL STATION  
YAKIMA TRAINING CENTER  
MISCELLANEOUS DETAILS 1

Plate number:  
C-7  
Sheet 12

This project was designed by the Seattle District U.S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear within this drawing. The use of the name of the Corps of Engineers or the name of the Engineer in Charge is not to be construed as an endorsement or approval of the design or construction of the project by the Corps of Engineers or the Professional Registrar.





OIL/WATER SEPARATOR SITE

NOT TO SCALE

SHEET 17, PL. C-12  
SKETCH 7

00800-20

R0005



# PUMP SCHEDULE

PUMP SYMBOL	PUMP STYLE	PRODUCT	DESIGN FLOW L/S (GPM)	DESIGN HEAD KPA (FT*)	2ND OPERATING POINT L/S (GPM)	2ND OPERATING POINT KPA (FT*)	QTY STAGES	MAX NPISHR KPA (FT H2O)	SUCTION/DISCHARGE DIA	MINIMUM EFFIC.	MOTOR KW (HP)
CP-1	VERT, IN-LINE API-610	JP-8	22 (350)	657 (220)	19 (300)	672 (225)	2	(32) 12	150/100mm (6"/4")*	76	22 30
CP-2	VERT, IN-LINE API-610	JP-8	22 (350)	657 (220)	19 (300)	672 (225)	2	(32) 12	150/100mm (6"/4")*	76	22 30
CP-3	VERT, IN-LINE API-610	MOGAS	22 (350)	284 (95)	19 (300)	346 (116)	1	(36) 12	150/100mm (6"/4")*	74	11 15
CP-4	VERT, IN-LINE API-610	DIESEL	22 (350)	296 (118)	19 (300)	358 (120)	1	(36) 12	150/100mm (6"/4")*	74	11 15
PRP-1		JP-8	0.2 (3)	119 (40)	---	---	---	---	20mm/20mm (3/4"/1/4")	---	0.37 1/2
SP-1	SUMP PUMP	FUEL/WATER	2.5 (40)	48 (16)	---	---	---	---	---/50mm (2") MIN	---	0.56 3/4
SP-2	SUMP PUMP	FUEL/WATER	2.5 (40)	48 (16)	---	---	---	---	---/50mm (2") MIN	---	0.56 3/4

\* HEAD IN FEET OF WATER

## AIR ELIMINATION VESSEL SCHEDULE

SYMBOL	STYLE	NOMINAL CAPACITY LITER	CONNECTIONS		REMARKS
			INLET	OUTLET	
	VERTICAL	1890	100mm(4")	100mm(4")	ASME 150LB. PRESSURE VESSEL, INTERIOR COATED IAW SPEC 09873, PROVIDE W/CLEANOUT, DRAIN, VENT, AND LEVEL SENSORS AS INDICATED
	"	"	"	"	
	"	"	150mm	150mm	

## FILTER/SEPARATOR SCHEDULE

SYMBOL	STYLE	PRODUCT	MINIMUM CAPACITY LPS (GPM)	CONNECTIONS		NUMBER OF STAGES	RELIEF VALVE (PSI)	REMARKS
				INLET	OUTLET			
FS-1	VERTICAL	JP-8	22 (350)	150mm (6")	150mm (6")	2	55	PROVIDE COMPLETE SPARE FILTER ELEMENT, AUTO WATER SHUT-OFF, AND RATE OF FLOW CONTROL VALVE; SEE C M-16
FS-2	"	JP-8	"	"	"	"	"	
FS-3	"	MOGAS	"	"	"	"	"	
FS-4	"	DIESEL	"	"	"	"	"	

## FUEL QUALITY MONITOR SCHEDULE

SYMBOL	STYLE	MINIMUM CAPACITY LPS (GPM)	CONNECTIONS		REMARKS
			INLET	OUTLET	
FOM-1	VERTICAL	22 (350)	100mm (4")	100mm (4")	PROVIDE IAW MIL-M-81380, W/ SPARE FILTER COALESCER ELEMENT
FOM-2	"	"	"	"	"
FOM-3	"	"	"	"	"
FOM-4	"	"	"	"	"

STYLE *
REMOTE SINGLE PRI
REMOTE SINGLE PRI
REMOTE SINGLE PRI
* DISPENSERS MAY

STYLE
TOP LOAD HOSE AS
TOP LOAD HOSE AS
BOTTOM LOAD HOSE
BOTTOM LOAD HOSE

SYMBOL	STYLE	MIN CAP LI
		T-1
T-2	"	"
T-3	"	"
T-4	HORIZONTAL	37
T-5	"	"

SYMBOL	ITEM	CW
P-1	WATER CLOSET (HANDICAP)	25mm (1")
P-2	LAVATORY	15mm (1/2")

## EXHAUST FAN SCHEDULE

SYMBOL	REMARKS

R0005

SHT. 31, PL. M-2  
SKETCH 9

GENERAL NOTES:

1. CLASS I DIVISION 2 HAZARDOUS LOCATION EXISTS WITHIN THE DIKE UP TO THE LEVEL OF THE TOP OF THE DIKE.
2. CLASS I DIVISION 2 HAZARDOUS LOCATIONS EXIST WITHIN 3 METERS OF TANK SHELLS AND ROOFS ABOVE THE LEVEL OF THE TOP OF THE DIKE.
3. CLASS I DIVISION 2 HAZARDOUS LOCATION EXISTS WITHIN .5 METER OF DISPENSERS IN ALL DIRECTIONS AND WITHIN 6.1 METER HORIZONTALLY FROM DISPENSERS UP TO .5 METER ABOVE GROUND.
4. CLASS I DIVISION 1 HAZARDOUS LOCATION EXISTS IN ROOM 03 OF THE ATTENDANT BUILDING.
5. CLASS I DIVISION 1 HAZARDOUS LOCATION EXISTS WITHIN 1 METER OF POINT OF VENTING TO ATMOSPHERE, EXTENDING IN ALL DIRECTIONS. CLASS I DIVISION 2 HAZARDOUS LOCATION EXISTS BETWEEN 1 METER AND 5 METERS FROM POINT OF VENTING TO ATMOSPHERE AND EXTENDING IN ALL DIRECTIONS. ALSO UP TO .5 METER ABOVE GRADE WITHIN A HORIZONTAL RADIUS OF 3 METERS FROM POINT OF LOADING CONNECTION.

6. TERMINATE ALL PAIRS AT BOTH ENDS, AT PEDESTAL AND AT RANGE CONTROL BUILDING 1820, 2ND FLOOR, COMMUNICATIONS ROOM. INSIDE RANGE CONTROL, TERMINATE TO EXISTING BACKBOARD. MUST MATCH EXISTING BUILDING ENTRANCE PROTECTED TERMINAL, RELTEC PART NUMBER TFO19440 AND BEPC100CF, 100 PAIR, STACKABLE.

7. CONTRACTOR TO PROVIDE ALL NECESSARY CONDUIT TO AND FROM BUILDING 1820. CONDUIT SHALL BE RUN NEATLY ALONG EXTERIOR OF WALL AS REQUIRED. CONDUIT SHALL BE EITHER 4" EMT, 4" JMC, OR 4" RGS. EACH COMMUNICATIONS OR FO CABLE SHALL HAVE A UNIQUE CONDUIT.

8. PROVIDE 48 FIBER FO CABLE BETWEEN COMMUNICATIONS HUT AND RANGE CONTROL. SEE PLATE E-4. PROVIDE 12 FIBER FO CABLE BETWEEN ATTENDANT BUILDING AND RANGE CONTROL.

9. WHERE SHOWN ON THIS DRAWING, DIRECT BURIAL OF COMMUNICATION CABLE IN PLACE OF CONCRETE ENCASUREMENT IS ACCEPTABLE. CABLE MUST BE BURIED 610 mm BELOW GRADE. WHERE TRANSVERSING ROADS, CABLE MUST BE PLACED IN 4" RGS CONDUIT.

*R0005*



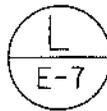
U.S. ARMY  
ENGINEER DISTRICT, SEATTLE  
CORPS OF ENGINEERS  
SEATTLE, WASHINGTON

SITE PLAN  
POWER  
(SHEET 55, PLATE E-2)

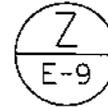
SKETCH NO. 10

DATE 15 DEC 98

LIGHTING POLE AND BASE  
TYP OF ALL LIGHT STANDARDS



TELEPHONE PEDESTAL  
(TYP)

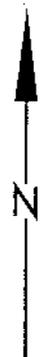


PC

EXISTING TELEPHONE CABLE  
200-PAIR #22 AWG

TELEPHONE CABLE, 200-PAIR #22 AWG  
DIRECT BURY 610mm BELOW SURFACE.  
CONDUIT AND CONCRETE NOT REQUIRED  
BETWEEN PEDESTALS

10 M R MIN.



COMPUTER

ROODS



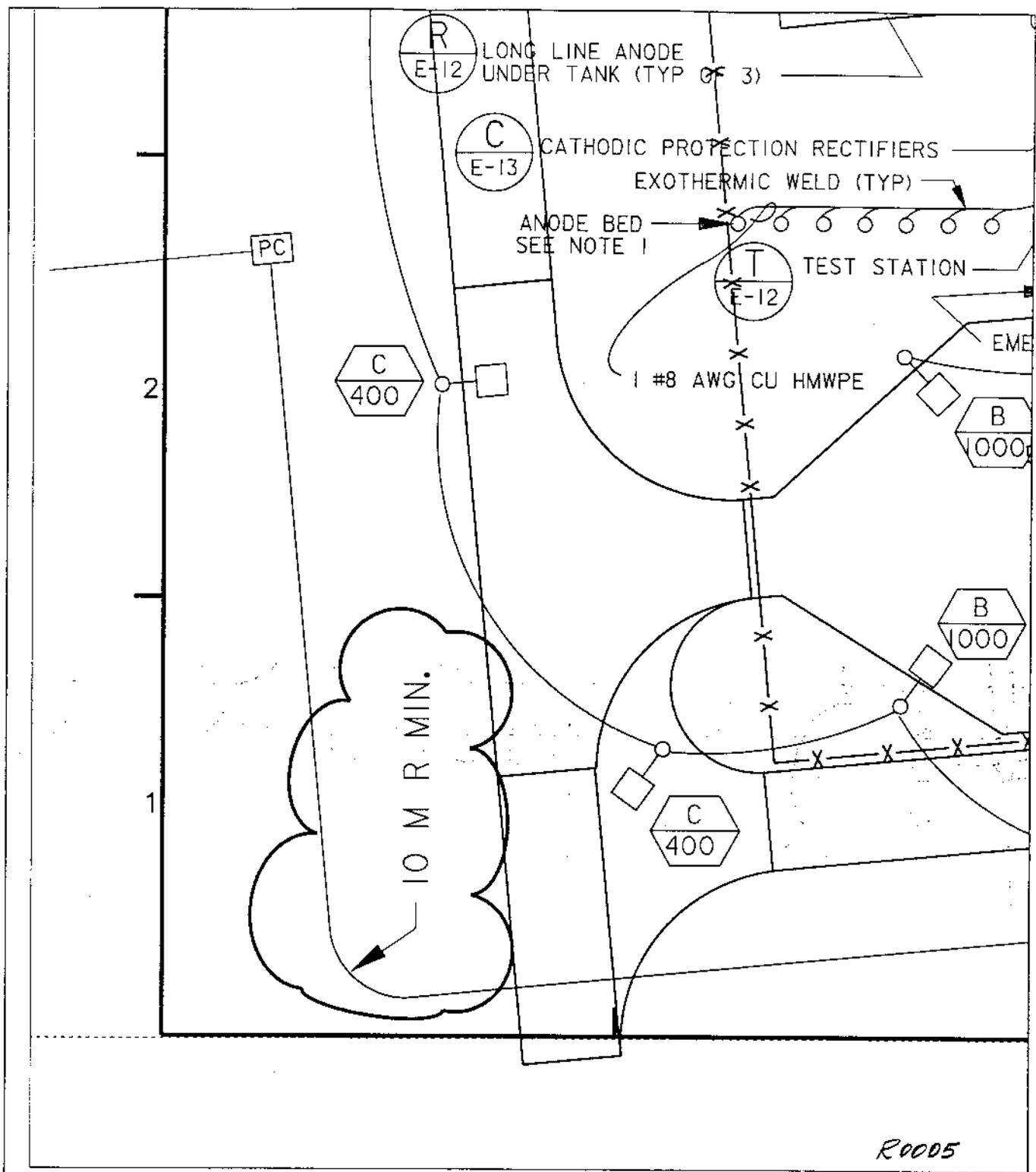
U.S. ARMY  
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CORPS OF ENGINEERS  
SEATTLE, WASHINGTON

1 : 400

SITE PLAN  
POWER  
(SHEET 55, PLATE E-2)

SKETCH NO. 11

DATE 15 DEC 98

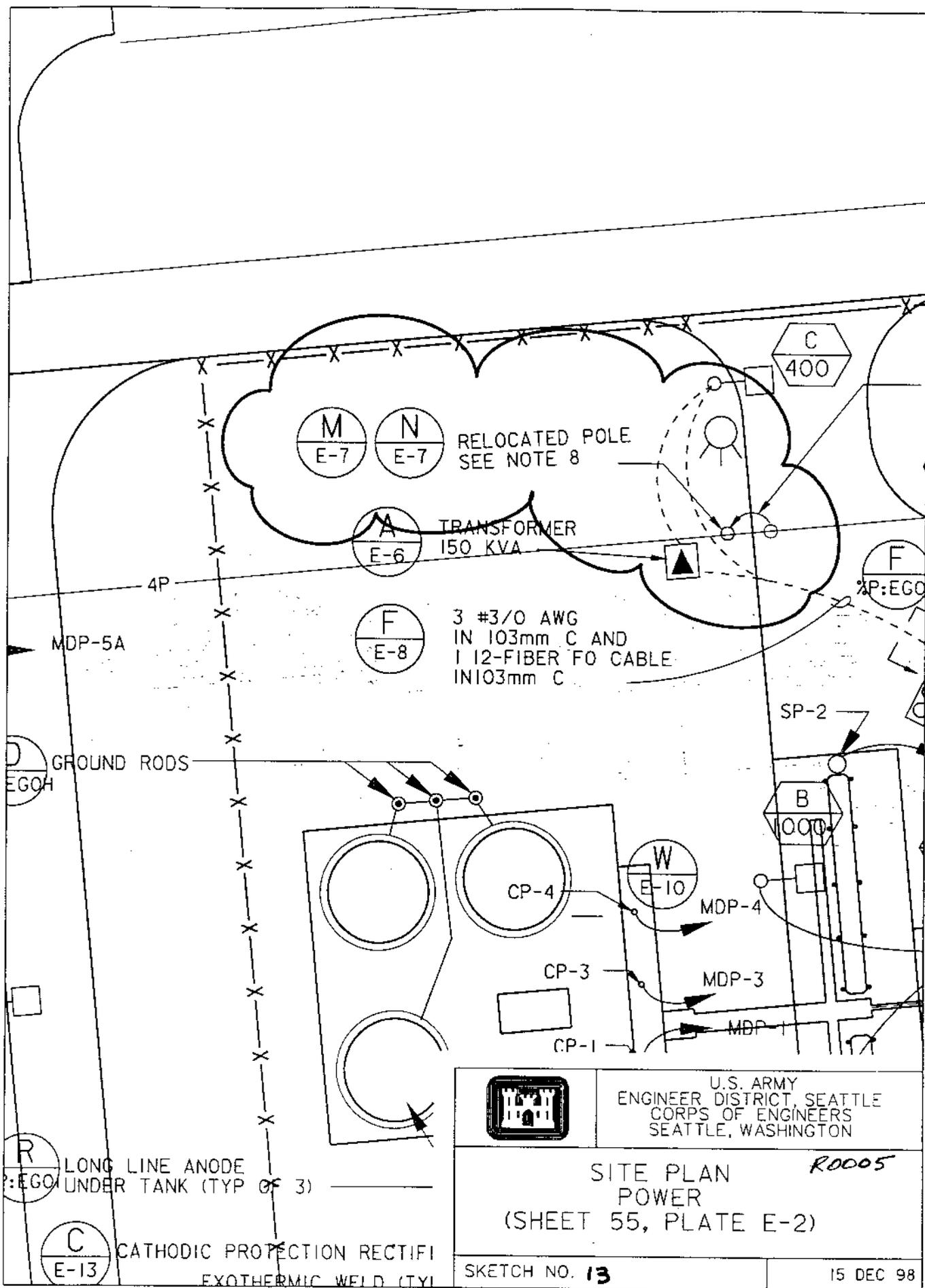


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 SEATTLE, WASHINGTON

SITE PLAN  
 POWER  
 (SHEET 55, PLATE E-2)

SKETCH NO. 12

DATE 15 DEC 98

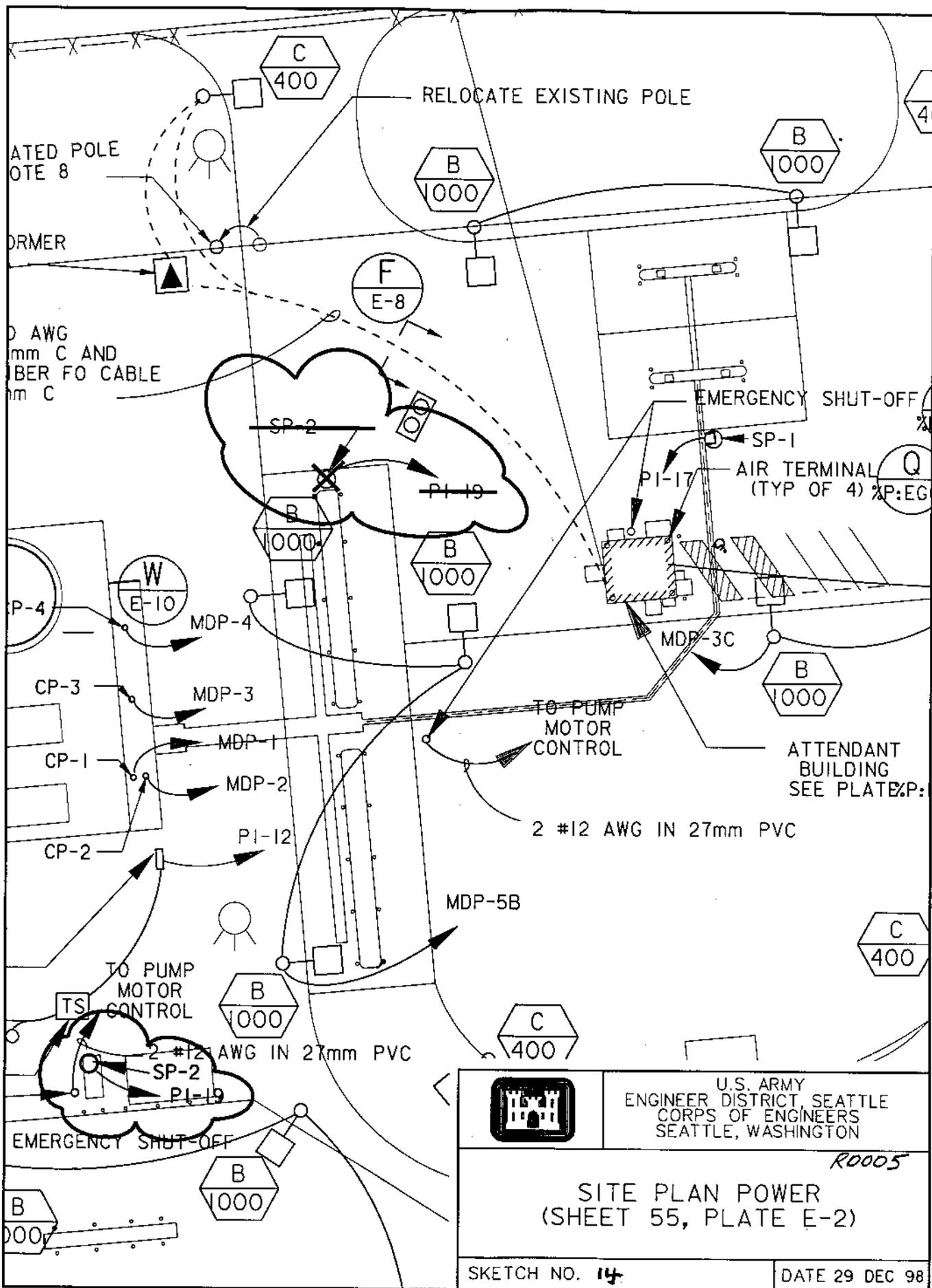


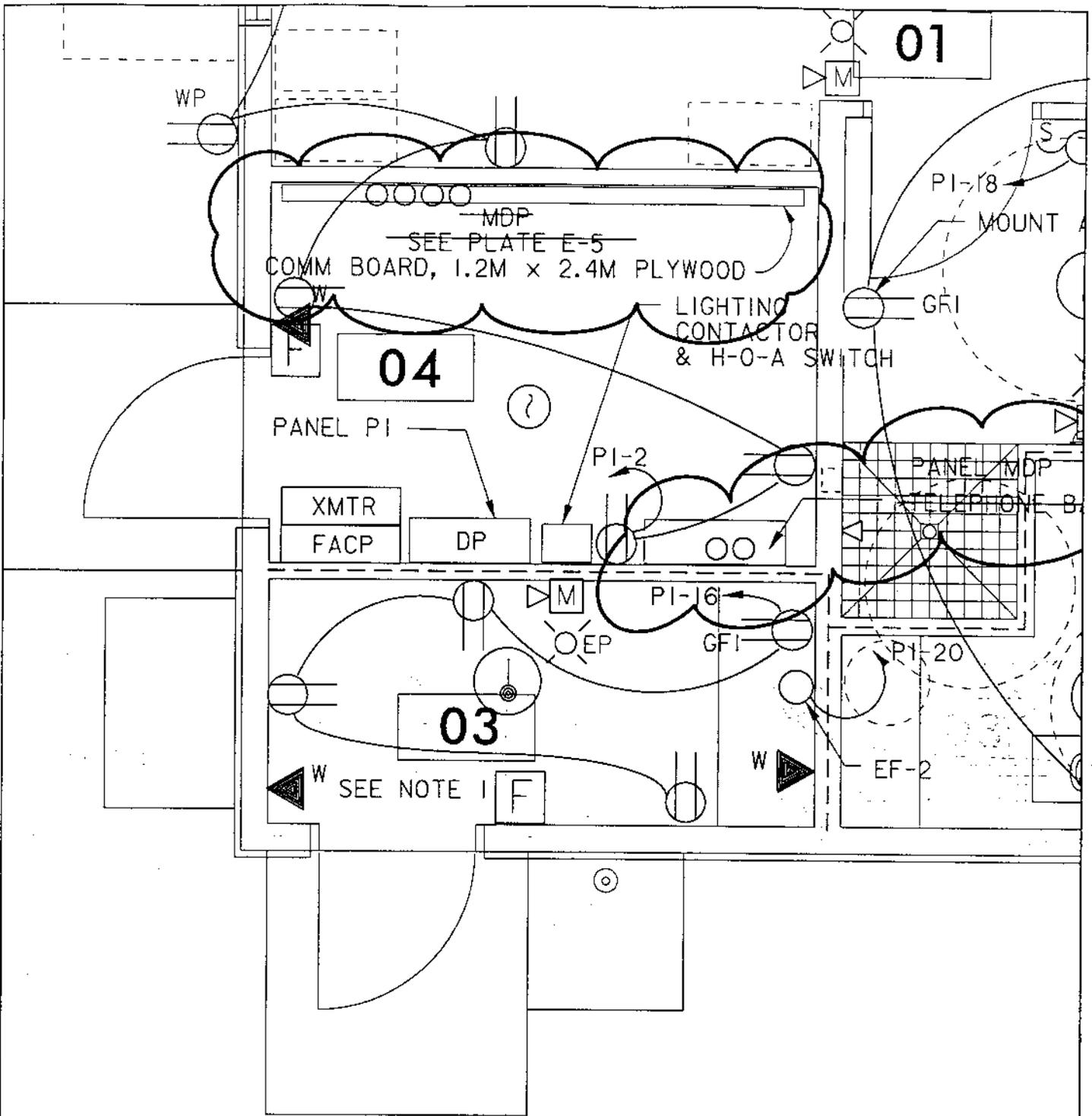
U.S. ARMY  
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 SEATTLE, WASHINGTON

R0005  
 SITE PLAN  
 POWER  
 (SHEET 55, PLATE E-2)

SKETCH NO. 13

15 DEC 98





# POWER AND AUXILIARY PLAN



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*R0005*

**ATTENDANT BUILDING**

**(SHEET 56, PLATE E-3)**

NOTES

I. AL  
PROVU

SKETCH NO. **15**

DATE 15 DEC 98

00800-28



NOTES:

1. ROUTE FIBER OPTIC CABLE ON EXISTING POWER POLES ALONG COLD CREEK ROAD. PROVIDE FO CABLE BETWEEN BASE DCO AND RANGE CONTROL. USE EXISTING MANHOLES ALONG FIFTH AVE AND "E" STREET BETWEEN BASE DCO AND THE TELEPHONE HUT MANHOLE FOR FIBER OPTIC (FO) CABLE. PROVIDE 10 METERS OF FIBER CABLE LOOPED IN EACH MANHOLE EXCEPT THE TELEPHONE HUT MANHOLE. PROVIDE 30 METERS OF FIBER OPTIC CABLE LOOPED AROUND THE TELEPHONE HUT MANHOLE.

2. PROVIDE RACK, RACK MOUNT INTERCONNECT BOX WITH 96 "ST" CONNECTORS AND OC-3 LINK.

3. PROVIDE RACK, RACK MOUNT INTERCONNECT BOX WITH 48 "ST" CONNECTORS, OC-3 AND OC-1 LINK. PROVIDE FO CABLE IN 53mm C INTO RANGE CONTROL BUILDING. FIELD VERIFY EXACT LOCATION.

4. CONNECT ALL CONDUITS TO THE LOWEST MANHOLE OPENINGS AVAILABLE. PROVIDE CONCRETE ENCASEMENT UNDER ROAD CROSSINGS AND DRIVEWAYS.

5. PROVIDE 53mm C RISER AND 53mm C TO MANHOLE. PROVIDE 53mm CONDUIT, MANHOLE, AND RISER ALONG COLD CREEK ROAD BETWEEN THE TELEPHONE HUT MANHOLE AND THE POWER POLE LINE EAST OF AMMO SUPPLY ROAD FOR FIBER OPTIC CABLE. CONDUIT UNDER AMMO SUPPLY ROAD SHALL BE ENCASED IN CONCRETE.

6. PROVIDE RACK, RACK MOUNT INTERCONNECT BOX, AND T-1 LINK IN ATTENDANT BUILDING.



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SEATTLE, WASHINGTON

*R0005*

SITE PLAN  
COMMUNICATIONS  
(SHEET 57, PLATE E-4)

SKETCH NO. **17**

DATE 12/7/98

PANEL MDP  
 225 AMP MAIN BREAKER FRAME W/ 225 AMP TRIP, SURFACE MOUNT.  
 480Y/277 VOLTS, 3 PHASE, 4 WIRE 10,000 SYM A.I.C. MIN.

CKT. NO.	NO. POLES	CKT. COND	TRIP AMP.	GROUND	CONDUIT	LOAD SERVED	CONNECTED LOAD-V.A.			FRAME SIZE	CONNECTED LOAD-V.A.			LOAD SERVED	CONDUIT	GROUND	TRIP AMP.	CKT. COND	NO. POLES	CKT. NO.	
							A $\phi$	B $\phi$	C $\phi$		A $\phi$	B $\phi$	C $\phi$								
1	3	6	80	-	2"	CP-1 (30 HP)	10000	10000	10000	100	10000	10000	10000	CP-2 (30 HP)	2"	-	80	6	3	2	
3	3	8	40	-	2"	CP-3 (15 HP)	5000	5000	5000	100	5000	5000	5000	CP-4 (15 HP)	2"	-	40	8	3	4	
5	1	8	30	10	1"	EXTERIOR LIGHTS	6000			100	1667	1667	1667	AC-1 (5 HP)	3/4"	12		12	3	6	
7	1	8	30	10	1"	EXTERIOR LIGHTS		5400		100	7200	7200	--	PANEL P1	1/2"	8		80	3	2	8
9	1	8	30	10	1"	EXTERIOR LIGHTS			5800	100				SPARE							10
11	1		20			SPARE								SPARE			20				12

TOTAL CONNECTED LOAD 127 (KVA) 90 % DEMAND = 114.3 DEMAND LOAD (KVA)

**NOTE:**

1. MDP PANEL SCHEDULE CIRCUIT NUMBERS MAY DENOTE 1, 2, OR 3 POLE BREAKER. CONTRACTOR SHALL INSTALL THE APPROPRIATE NUMBER OF BREAKER POLES AS DICTATED IN THE "NO. POLES" COLUMN.

PANEL P1  
 225 AMP MAIN BREAKER FRAME W/ 150 AMP TRIP, SURFACE MOUNT  
 240/120 VOLTS, 1 PHASE, 3 WIRE 10,000 SYM A.I.C. MIN.

CKT. NO.	NO. POLES	CKT. COND	TRIP AMP.	GROUND	CONDUIT	LOAD SERVED	CONN LOAD-VA		FRAME SIZE	CONN LOAD-VA		LOAD SERVED	CONDUIT	GROUND	TRIP AMP.	CKT. COND	NO. POLES	CKT. NO.	
							A v	B v		A v	B v								
1	1	12	20	12	3/4"	RECEPTACLES	1080			1260		RECEPTACLES	3/4"	12	20	12	1	2	
3	2	10	30	10	3/4"	WATER HEATER (HWH-1)		9000			800	CABINET HEATER (CH-1)	3/4"	12	20	12	2	4	
5							9000				800								6
7	2	12	20	12	3/4"	UNIT HEATER (UH-1)		1250			900	AUTO FUEL MONITOR SYS	3/4"	12	20	12	1	8	
9							1250				100	FIRE ALARM*	3/4"	12	20	12	1	10	
11	1	12	20	12	3/4"	FAN COIL UNIT		1600			100	CP RECTIFIER	3/4"	12	20	12	2	12	
13							1600				100								14
15		12	20	12	3/4"	LIGHTS		800			720	RECEPTACLES	3/4"	12	20	12	1	16	
17	1	10	20	10	3/4"	SP-1	750				100	EF-1	3/4"	12	20	12	1	18	
19	1	10	20	10	3/4"	SP-2		750			100	EF-2	3/4"	12	20	12	1	20	
21			20			SPARE						SPARE			20				22
24			20			SPARE						SPARE			20				24

TOTAL CONNECTED LOAD 32.0  
 \* PROVIDE CIRCUIT BRE.



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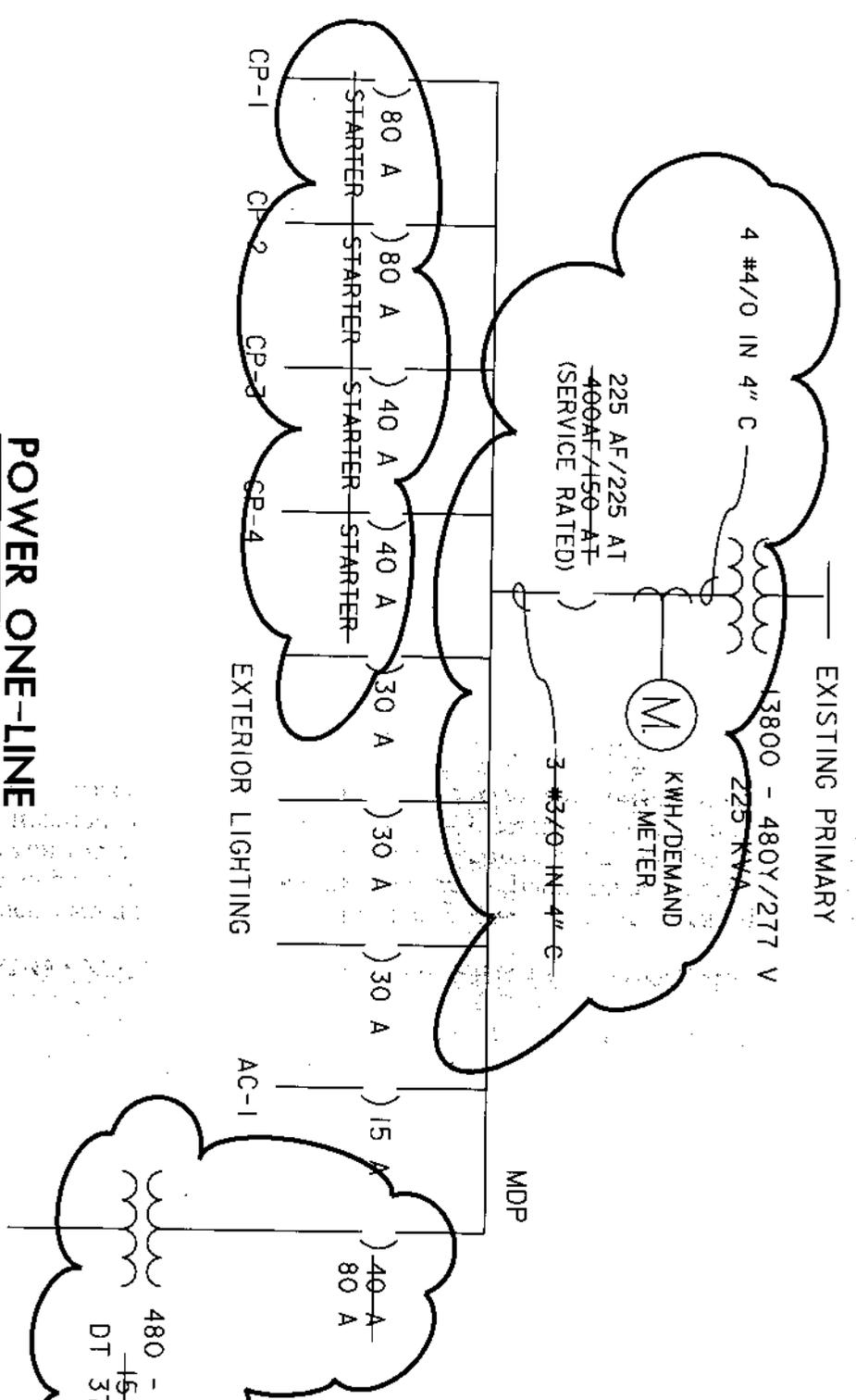
**PANEL SCHEDULES  
 & ONE LINES  
 (SHEET 58, PLATE E-5)**

SKETCH NO. 18

DATE 15 DEC 98

00800-31

F G H



**POWER ONE-LINE**

NOTES:

1. A STARTER FOR EACH PUMP SHALL BE PROVIDED PER NFPA 70 (NEC) REQUIREMENTS, THESE SPECIFICATIONS AND MANUFACTURER'S RECOMMENDATIONS. A DISCONNECTING SWITCH, OR OTHER APPROVED DISCONNECTING MEANS SHALL BE WITHIN 10' M OF PUMP. DISCONNECTING SWITCH SHALL BE VISABLE FROM PUMP.

PANEL P1



U.S. ARMY  
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SEATTLE, WASHINGTON

R0005

**PANEL SCHEDULES  
& ONE-LINES  
(SHEET 58, PLATE E-5)**

SKETCH NO. 19

DATE 15 DEC 98

00800-32

END OF SECTION

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General Decision Number WA980001

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General Decision Number WA980001

Superseded General Decision No. WA970001

State: Washington

Construction Type:

DREDGING  
HEAVY  
HIGHWAY

County(ies):

STATEWIDE

HEAVY AND HIGHWAY AND DREDGING CONSTRUCTION PROJECTS  
(Excludes D. O. E. Hanford Site in Benton and Franklin Counties)

Modification Number	Publication Date
0	02/13/1998
1	03/27/1998
2	04/10/1998
3	05/22/1998
4	06/12/1998
5	06/19/1998
6	07/10/1998
7	07/24/1998
8	07/31/1998
9	08/28/1998
10	10/09/1998
11	10/16/1998
12	11/20/1998
13	01/08/1999

COUNTY(ies):

STATEWIDE

CARP0001W 06/01/1998



Anyone working on a HAZMAT job (task), where HAZMAT certification is required, shall be compensated at a premium, in addition to the classification working in as follows:

LEVEL D + \$.25 per hour - This is the lowest level of protection. No respirator is used and skin protection is minimal.

LEVEL C + \$.50 per hour - This level uses an air purifying respirator or additional protective clothing.

LEVEL B + \$.75 per hour - Uses same respirator protection as Level A. Supplied air line is provided in conjunction with a chemical "splash suit".

LEVEL A +\$1.00 per hour - This level utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line.

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CARP00030 06/01/1998

Rates                      Fringes

SOUTHWEST WASHINGTON: CLARK, COWLITZ, KLICKITAT, LEWIS  
(Piledriver only), PACIFIC (South of a straight line made by extending the north boundary line of Wahkiakum County west to Willapa Bay to the Pacific Ocean), SKAMANIA AND WAHKIAKUM COUNTIES and INCLUDES THE ENTIRE PENINSULA WEST OF WILLAPA BAY

SEE ZONE DESCRIPTION FOR CITIES BASE POINTS

**ZONE 1:**

CARPENTERS; ACOUSTICAL	24.27	6.42
DRYWALL	24.27	6.42
FLOOR LAYERS & FLOOR FINISHERS (the laying of all hardwood floors nailed and mastic set, parquet and wood-type tiles, and block floors, the sanding and finishing of floors, the preparation of old and new floors when the materials mentioned above are to be installed); INSULATORS (fiberglass and similar irritating materials	24.42	6.42
MILLWRIGHTS	24.77	6.42
PILEDRIVERS	24.77	6.42
DIVERS	55.03	6.42
DIVERS TENDERS	24.59	6.42

**DEPTH PAY**

50 TO 100 FEET	\$1.00 PER FOOT OVER 50 FEET
100 TO 150 FEET	1.50 PER FOOT OVER 100 FEET
150 TO 200 FEET	2.00 PER FOOT OVER 150 FEET

Zone Differential (Add up Zone 1 rates):

Zone 2 - \$0.85

Zone 3 - 1.25

Zone 4 - 1.70

Zone 5 - 2.00

Zone 6 - 3.00

BASEPOINTS: ASTORIA, LONGVIEW, PORTLAND, THE DALLES,  
AND VANCOUVER, (NOTE: All dispatches for Washington State  
Counties: Cowlitz, Wahkiakum and Pacific shall be from Longview  
Local #1707 and mileage shall be computed from that point.)

ZONE 1: Projects located within 30 miles of the respective  
city hall of the above mentioned cities

ZONE 2: Projects located more than 30 miles and less than 40  
miles of the respective city of the above mentioned  
cities

ZONE 3: Projects located more than 40 miles and less than 50  
miles of the respective city of the above mentioned  
cities

ZONE 4: Projects located more than 50 miles and less than 60  
miles of the respective city of the above mentioned  
cities.

ZONE 5: Projects located more than 60 miles and less than 70  
miles of the respective city of the above mentioned  
cities

ZONE 6: Projects located more than 70 miles of the respected  
city of the above mentioned cities

-----  
CARP0770D 06/01/1998

WESTERN WASHINGTON: CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON,  
KING, KITSAP, LEWIS (excludes piledrivers only), MASON,  
PACIFIC (North of a straightline made by extending the north  
boundary line of Wahkiakum County west to the Pacific Ocean),  
PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM  
COUNTIES

	Rates	Fringes
CARPENTERS AND DRYWALL APPLICATORS	24.50	6.27
CARPENTERS ON CREOSOTE MATERIAL	24.60	6.27
SAWFILERS, STATIONARY POWER SAW OPERATORS, FLOOR FINISHER, FLOOR LAYER, SHINGLER, FLOOR SANDER OPERATOR AND OPERATORS OF OTHER STATIONARY WOOD WORKING TOOLS	24.63	6.27
MILLWRIGHT AND MACHINE ERECTORS	25.50	6.27
ACOUSTICAL WOKRERS	24.66	6.27
PILEDRIVER, DRIVING, PULLING,		

CUTTING, PLACING COLLARS, SETTING, WELDING OR CRESOTE TREATED MATERIAL, ALL PILING PILEDRIIVER, BRIDGE DOCK & WHARF CARPENTERS	24. 70	6. 27
DIVERS	60. 52	6. 27
DIVERS TENDER	26. 92	6. 27

(HOURLY ZONE PAY APPLICABLE TO ALL CLASSIFICATIONS EXCEPT MILLWRIGHT AND PILEDRIIVER)

Hourly Zone Pay shall be paid on jobs located outside of the free zone computed from the city center of the following listed cities:

Seattle	Olympia	Bellingham
Auburn	Bremerton	Anacortes
Renton	Shelton	Yakima
Aberdeen-Hoquiam	Tacoma	Wenatchee
Ellensburg	Everett	Port Angeles
Centralia	Mount Vernon	Sunnyside
Chelan	Pt. Townsend	

Zone Pay	
0 - 25 radius miles	Free
25- 35 radius miles	\$1. 00/hour
35- 45 radius miles	\$1. 15/hour
45- 55 radius miles	\$1. 35/hour
Over 55 radius miles	\$1. 55/hour

(HOURLY ZONE PAY - MILLWRIGHT AND PILEDRIIVER ONLY)

Hourly Zone Pay shall be computed from Seattle Union Hall, Tacoma City center, and Everett City center

Zone Pay	
0 - 25 radius miles	Free
25- 45 radius miles	\$ . 70/hour
Over 45 radius miles	\$1. 50/hour

CENTRAL WASHINGTON: CHELAN, DOUGLAS (WEST OF THE 120TH MERIDIAN), KITTITAS, OKANOGAN (WEST OF THE 120TH MERIDIAN) AND YAKIMA COUNTIES

CARPENTERS AND DRYWALL APPLICATORS	19. 77	6. 27
CARPENTERS ON CREOSOTED MATERIAL	19. 87	6. 27
SAWFILERS, STATIONARY POWER SAW OPERATORS, FLOOR FINISHER,		

FLOOR LAYER, SHINGLERS, FLOOR SANDER OPERATORS	19. 90	6. 27
MILLWRIGHT AND MACHINE ERECTORS	25. 50	6. 27
PILEDRIVER, DRIVING, PULLING, CUTTING, PLACING COLLARS, SETTING, WELDING OR CRESOTE TREATED MATERIAL, ALL PILING	24. 70	6. 27
PILEDRIVER, BRIDGE DOCK AND WHARF CARPENTERS	24. 50	6. 27
DIVERS	60. 52	6. 27
DIVERS TENDER	26. 93	6. 27

(HOURLY ZONE PAY APPLICABLE TO ALL CLASSIFICATIONS EXCEPT MILLWRIGHT AND PILEDRIVER)

Hourly Zone Pay shall be paid on jobs located outside

of the free zone computed from the city center of the following listed cities:

Seattle	Olympia	Bellingham
Auburn	Bremerton	Anacortes
Renton	Shelton	Yakima
Aberdeen-Hoquiam	Tacoma	Wenatchee
Ellensburg	Everett	Port Angeles
Centralia	Mount Vernon	Sunnyside
Chelan	Pt. Townsend	

Zone Pay	
0 - 25 radius miles	Free
25- 35 radius miles	\$1. 00/hour
35- 45 radius miles	\$1. 15/hour
45- 55 radius miles	\$1. 35/hour
Over 55 radius miles	\$1. 55/hour

(HOURLY ZONE PAY - MILLWRIGHT AND PILEDRIVER ONLY)

Hourly Zone Pay shall be computed from Seattle Union Hall, Tacoma City center, and Everett City center

Zone Pay	
0 - 25 radius miles	Free
25- 45 radius miles	\$ . 70/hour
Over 45 radius miles	\$1. 50/hour

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ELEC0046A 06/01/1997

CALLAM, JEFFERSON, KING AND KITSAP COUNTIES

	Rates	Fringes
ELECTRICIANS	25.81	7.255+3%
CABLE SPLICERS	28.39	7.255+3%

ELEC0048C 01/01/1998

CLARK, KLICKITAT SKAMANIA COUNTIES

	Rates	Fringes
ELECTRICIANS	26.50	8.85+3%
CABLE SPLICERS	26.75	8.85+3%

\* ELEC0073A 01/01/1999

ADAMS, FERRY, LINCOLN, PEND OREILLE, SPOKANE, STEVENS, WHITMAN COUNTIES

	Rates	Fringes
ELECTRICIANS	22.77	7.23+3%
CABLE SPLICERS	23.17	7.23+3%

ELEC0076B 07/01/1998

GRAYS HARBOR, LEWIS, MASON, PACIFIC, PIERCE, AND THURSTON COUNTIES

	Rates	Fringes
ELECTRICIANS	24.37	9.04+3%
CABLE SPLICERS	26.81	9.04+3%

ELEC0077C 02/01/1998

LINE CONSTRUCTION

	Rates	Fringes
CABLE SPLICERS	27.72	6.00+3.5%
LINEMEN, POLE SPRAYERS,		
HEAVY LINE EQUIPMENT MAN	25.00	6.00+3.5%
LINE EQUIPMENT MEN	21.54	4.75+3.5%
POWDERMEN, JACKHAMMERMEN	18.81	4.75+3.5%
GROUND MEN	17.66	4.75+3.5%
TREE TRIMMER	18.83	4.75+3.5%

ELEC0112E 06/01/1998

ASOTIN, BENTON, COLUMBIA, FRANKLIN, GARFIELD, KITTITAS,  
WALLA WALLA, YAKIMA COUNTIES

	Rates	Fringes
ELECTRICIANS	26.20	6.83+3%
CABLE SPLICERS	27.51	6.83+3%

ELEC0191C 06/01/1998

ISLAND, SAN JUAN, SNOHOMISH, SKAGIT AND WHATCOM COUNTIES

	Rates	Fringes
ELECTRICIANS	25.34	6.63+3%
CABLE SPLICERS	27.87	6.63+3%

ELEC0191D 06/01/1998

CHELAN, DOUGLAS, GRANT AND OKANOGAN COUNTIES

	Rates	Fringes
ELECTRICIANS	23.19	6.63+3%
CABLE SPLICERS	25.51	6.63+3%

ELEC0970A 06/01/1998

COWLITZ AND WAHKIAKUM COUNTIES

	Rates	Fringes
ELECTRICIANS	25.05	7.50+3%
CABLE SPLICERS	27.56	7.50+3%

ENGI0302E 06/01/1998

CHELAN (WEST OF THE 120TH MERIDIAN), CLALLAM, DOUGLAS (WEST OF THE 120TH MERIDIAN), GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, KITTITAS, MASON, OKANOGAN (WEST OF THE 120TH MERIDIAN), SAN JUAN, SKAGIT, SNOHOMISH, WHATCOM AND YAKIMA (WEST OF THE 120TH MERIDIAN) COUNTIES

PROJECTS

CATEGORY A PROJECTS (excludes Category B projects, as show below)

POWER EQUIPMENT OPERATORS:

Zone 1 (0-25 radius miles):

GROUP 1AAA	26.66	7.13
GROUP 1AA	26.16	7.13
GROUP 1A	25.66	7.13
GROUP 1	25.16	7.13
GROUP 2	24.72	7.13
GROUP 3	24.36	7.13
GROUP 4	22.26	7.13

Zone 2 (26-45 radius miles) - Add \$ .70 to Zone 1 rates

Zone 3 (Over 45 radius miles) - Add \$1.00 to Zone 1 rates

BASEPOINTS: Bellingham, Mount Vernon, Kent, Port Angeles, Port Townsend, Aberdeen, Shelton, Bremerton, Wenatchee, Yakima, Seattle, Everett

#### POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-over 300 tons or 300 ft. of boom (including job with attachments)

GROUP 1AA - Cranes - 200 tons to 300 tons or 250 ft. of boom (including jib and attachments); Tower crane over 175 ft. in height, base to boom

GROUP 1A - Cranes - 100 tons thru 199 tons or 150' of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Tower crane up to 175 ft. in height base to boom; Loader-overhead, 8 yards and over; Shovel, excavator, backhoes-6 yards and over with attachments

GROUP 1 - Cableway; Cranes-45 tons thru 99 tons, under 150 ft. of boom (including jib with attachments); Crane-overhead, bridge type, 45 tons thru 99 tons; Shovel, excavator, backhoes over 3 yards and under 6 yards; Hard tail end dump articulating off-road equipment 45 yards and over; Loader-overhead, 6 yards to, but not including 8 yards; Mucking machine, mole, tunnel, drill and/or shield; Quad 9, HD 41, d-10; Remote control operator on rubber tired earth moving equipment; Rollagon; Scrapers-self-propelled-45 yards and over; Slipform pavers; Transporters, all track or truck type

GROUP 2 - Barrier machine (zipper); Barch Plant opeator-concrete; Bump cutter; Cranes-20 tons thru 44 tons with attachments; Cranes-overheads, bridge type-20 tons through 44

tons; Chipper; Concrete pump-truck mount with boom attachment; Crusher; Deck Engineer/Deck Winches (power); Drilling machine; Excavator, shovel backhoe-3 yards and under; Finishing machine

Bidwell, Gamaco and similar equipment; Guardrail punch; Horizontal/directional drill operator; Loaders, overhead under 6 yds.; Loaders-plant feed; Locomotives-all; Mechanics-all; Mixers-asphalt plant; Motor patrol graders-finishing; Pildriver (other than crane mount); Roto-mill, roto-grinder; Screedman, Spreader, Topside Operator-Blaw Knox, Cedar Rapids, Jaeger, Caterpillar, Barbar Green; Scraper-self-propelled, hard tail end dump, articulating off-road equipment-under 45 yards; Subgrader trimmer; Tractors, backhoes-over 75 hp; Transfer material service machine-shuttle buggy, blow knox, roadtec; Truck crane oiler/driver-100 tons and over; Truck mount portable conveyor; Yo Yo Pay Dozer

GROUP 3 - Conveyors; Cranes-thru 19 tons with attachments; Cranes-A-frame over 10 tons; Drill oilers-auger type, truck or crane mount; Dozers D9 and under; Forklifts-3000 lbs and over with attachments; horizontal/directional drill locator; Outside hoists-(elevators and manlifts), air tuggers, strao tower bucket elevators; Hydralifts/boom truck-over 10 tons; Loader-elevating type belt; Motor Patrol Grader-non-finishing; Plant Oiler-asphalt, crusher; Pumps-concrete; Roller, plant mix or multi-lift materials; Saws-concrete; Scrapers-concrete and carryall; Service engineers-equipment; Trenching machines; Truck crane oiler/driver-under 100 tons Tractors, backhoes-under 75 hp

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor; Concrete Finish Machine-laser screed; Cranes-A-frame-10 tons and under; Elevator and manlift-permanent and shaft type; Forklifts-under 3000 lbs. with attachments; Gradechecker, stakehop; Hydralifts, boom trucks-10 tons and under; Oil distributors, blower distribution and mulch seeding operator; Pavement breaker; Post Hole Digger-mechanical; Power Plant; Pumps-water; Rigger and Bellman; Roller-other than plant mix; Wheel Tractors, farmall type; Shot crete/gunite equipment operator

CATEGORY B PROJECTS - 90% of the basic hourly rate for each group plus full fringe benefits applicable to Category A projects shall apply to the following projects. Reduced rates may be paid on the following:

1. Projects involving work on structures such as buildings and structures whose total value is less than \$1.5 million excluding mechanical, electrical, and utility portions of the contract.
2. Projects of less than \$1 million where no building is involved. Surfacing and paving included, but utilities excluded.
3. Marine projects (docks, wharfs, etc.) less than \$150,000.

**WORK PERFORMED ON HYDRAULIC DREDGES:**

Total Project Cost \$300,000 and over

GROUP 1	23.90	6.88
GROUP 2	23.98	6.88
GROUP 3	24.34	6.88

GROUP 4	24.39	6.88
GROUP 5	25.78	6.88
GROUP 6	23.90	6.88

- GROUP 1: Assistant Mate (Deckhand)
- GROUP 2: Oiler
- GROUP 3: Assistant Engineer (Electric, Diesel, Steam or Booster Pump); Mates and Boatmen
- GROUP 4: Craneman, Engineer Welder
- GROUP 5: Leverman, Hydraulic
- GROUP 6: Maintenance

Total Project cost under \$300,000

GROUP 1	21.51	6.88
GROUP 2	21.58	6.88
GROUP 3	21.91	6.88
GROUP 4	21.95	6.88
GROUP 5	23.20	6.88
GROUP 6	21.51	6.88

- GROUP 1: Assistant Mate (Deckhand)
- GROUP 2: Oiler
- GROUP 3: Assistant Engineer (Electric, Diesel, Steam, or Booster Pump); Mates and Boatmen
- GROUP 4: Craneman, Engineer Welder
- GROUP 5: Leverman, Hydraulic
- GROUP 6: Maintenance

HEAVY WAGE RATES (CATEGORY A) APPLIES TO CLAM SHELL DREDGE, HOE AND DIPPER, SHOVELS AND SHOVEL ATTACHMENTS, CRANES AND BULLDOZERS.

HANDLING OF HAZARDOUS WASTE MATERIALS: Personnel in all craft classifications subject to working inside a federally designated hazardous perimeter shall be eligible for compensation in accordance with the following group schedule relative to the level of hazardous waste as outlined in the specific hazardous waste project site safety plan.

- H-1 Base wage rate when on a hazardous waste site when not outfitted with protective clothing
- H-2 Class "C" Suit - Base wage rate plus \$.25 per hour.
- H-3 Class "B" Suit - Base wage rate plus \$.50 per hour.
- H-4 Class "A" Suit - Base wage rate plus \$.75 per hour.

ENGI0370C 06/01/1998

	Rates	Fringes
ADAMS, ASOTIN, BENTON, CHELAN (EAST OF THE 120TH MERIDIAN), COLUMBIA, DOUGLAS (EAST OF THE 120TH MERIDIAN), FERRY, FRANKLIN,		

GARFIELD, GRANT, LINCOLN, OKANOGAN (EAST OF THE 120TH MERIDIAN),  
 PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN AND YAKIMA  
 (EAST OF THE 120TH MERIDIAN) COUNTIES

ZONE 1:

POWER EQUIPMENT OPERATORS:

GROUP 1A	19.91	5.40
GROUP 1	20.45	5.40
GROUP 2	20.76	5.40
GROUP 3	21.35	5.40
GROUP 4	21.51	5.40
GROUP 5	21.66	5.40
GROUP 6	21.93	5.40
GROUP 7	22.20	5.40
GROUP 8	23.26	5.40

ZONE DIFFERENTIAL (Add to Zone 1  
 rate): Zone 2 - \$2.00

Zone 1: Within 45 mile radius of Spokane, Moses Lake, Pasco,  
 Washington; Lewiston, Idaho

Zone 2: Outside 45 mile radius of Spokane, Moses Lake, Pasco,  
 Washington; Lewiston, Idaho

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1A: Boat Operator; Crush Feeder; Oiler; Steam Cleaner

GROUP 1: Bit Grinders; Bolt Threading Machine; Compressors  
 (under 2000 CFM, gas, diesel, or electric power); Deck Hand;  
 Drillers Helper (Assist driller in making drill rod connections,  
 service drill engine and air compressor, repair drill rig and  
 drill tools, drive drill support truck to and on the job site,  
 remove drill cuttings from around bore hole and inspect drill rig  
 while in operation); Fireman & Heater Tender; Grade Checker;  
 Hydro-seeder, Mulcher, Nozzlemán; Oiler Driver, & Cable Tender,  
 Mucking Machine; Pumpman; Rollers, all types on subgrade,  
 including seal and chip coatings (farm type, Case, John Deere &  
 similar, or Compacting Vibrator), except when pulled by Dozer  
 with operable blade; Welding Machine

GROUP 2: A-frame Truck (single drum); Assistant Refrigeration  
 Plant (under 1000 ton); Assistant Plant Operator, Fireman or  
 Pugmíxer (asphalt); Bagley or Stationary Scraper; Belt Finishing  
 Machine; Blower Operator (cement); Cement Hog; Compressor (2000  
 CFM or over, 2 or more, gas diesel or electric power); Concrete

Saw (multiple cut); Distributor Leverman; Ditch Witch or similar; Elevator Hoisting Materials; Dope Pots (power agitated); Fork Lift or Lumber Stacker, hydra-lift & similar; Gin Trucks (pipeline); Hoist, single drum; Loaders (bucket elevators and conveyors); Longitudinal Float; Mixer (portable-concrete); Pavement Breaker, Hydra-Hammer & similar; Power Broom; Railroad Ballast Regulation Operator (self-propelled); Railroad Power Tapper Operator (self-propelled); Railroad Tapper Jack Operator (self-propelled); Spray Curing Machine (concrete); Spreader Box (self-propelled); Straddle Buggy (Ross & similar on construction job only); Tractor (Farm type R/T with attachment, except Backhoe); Tugger Operator

GROUP 3: A-frame Truck (2 or more drums); Assistant Refrigeration Plant & Chiller Operator (over 1000 ton); Backfillers (Cleveland & similar); Batch Plant & Wet Mix

Operator, single unit (concrete); Belt-Crete Conveyors with power pack or similar; Belt Loader (Kocal or similar); Bending Machine; Bob Cat; Boring Machine (earth); Boring Machine (rock under 8" bit) (Quarry Master, Joy or similar); Bump Cutter (Wayne, Saginaw or similar); Canal Lining Machine (concrete); Chipper (without crane); Cleaning & Doping Machine (pipeline); Deck Engineer; Elevating Belt-type Loader (Euclid, Barber Green & similar); Elevating Grader-type Loader (Dumor, Adams or similar); Generator Plant Engineers (diesel or electric); Gunitite Combination Mixer & Compressor; Locomotive Engineer; Mixermobile; Mucking Machine; Posthole Auger or Punch; Pump (grout or jet); Soil Stabilizer (P & H or similar); Spreader Machine; Tractor (to D-6 or equivalent) and Traxcavator; Traverse Finish Machine; Turnhead Operator

GROUP 4: Concrete Pumps (squeeze-crete, flow-crete, pump-crete, Whitman & similar); Curb Extruder (asphalt or concrete); Drills (churn, core, calyx or diamond) (operate drilling machine, drive or transport drill rig to and on job site and weld well casing); Equipment Serviceman; Greaser & Oiler; Hoist (2 or more drums or Tower Hoist); Loaders (overhead & front-end, under 4 yds. R/T); Refrigeration Plant Engineer (under 1000 ton); Rubber-tired Skidders (R/T with or without attachments); Surface Heater & Plant Machine; Trenching Machines (under 7 ft. depth capacity); Turnhead (with re-screening); Vacuum Drill (reverse circulation drill under 8" bit)

GROUP 5: Backhoe (under 45,000 gw); Backhoe & Hoe Ram (under 3/4 yd.); Carrydeck & Boom Truck (under 25 tons); Cranes (25 tons & under), all attachments including clamshell, dragline; Derricks & Stifflegs (under 65 tons); Drilling Equipment (8" bit & over) (Robbins, reverse circulation & similar) (operates drilling machine, drive or transport drill rig to and on job site and weld well casing); Hoe Ram; Piledriving Engineers; Paving (dual drum); Railroad Track Liner Operatr (self-propelled); Refrigeration Plant Engineer (1000 tons & over); Signalman

(Whirleys, Highline Hammerheads or similar)

GROUP 6: Asphalt Plant Operator; Automatic Subgrader (Ditches & Trimmers)(Autograde, ABC, R. A. Hansen & similar on grade wire); Backhoe (45,000 gw and over to 110,000 gw); Backhoes & Hoe Ram (3/4 yd. to 3 yd.); Batch Plant (over 4 units); Batch & Wet Mix Operator (multiple units, 2 & incl. 4); Blade Operator (motor patrol & attachments, Athey & Huber); Boom Cats (side); Cable Controller (dispatcher); Clamshell Operator (under 3 yds.); Compactor (self-propelled with blade); Concrete Pump Boom Truck; Concrete Slip Form Paver; Cranes (over 25 tons, to and including 45 tons), all attachments including clamshell, dragline; Crusher, Grizzle & Screening Plant Operator; Dozer, 834 R/T & similar; Draglines (under 3 yds.); Drill Doctor; H. D. Mechanic; H. D. Welder; Loader Operator (front-end & overhead, 4 yds. incl. 8 yds.); Multiple Dozer Units with single blade; Paving Machine (asphalt and concrete); Quad-Track or similar equipment; Roller (finishing asphalt pavement); Roto Mill (pavement grinder); Scrapers, all, rubber-tired; Screed Operator; Shovel (under 3 yds.); Tractors (D-6 & equivalent & over); Trenching Machines (7 ft. depth & over); Tug Boat Operator Vactor guzzler, super sucker

GROUP 7: Backhoe (over 110,000 gw); Backhoes & Hoe Ram (3 yds & over); Blade (finish & bluetop) Automatic, CMI, ABC, Finish Athey & Huber & similar when used as automatic; Cableway Operators; Concrete Cleaning/Decontamination machine operator; Cranes (over 45 tons to but not including 85 tons), all attachments including clamshell and dragline; Derricks & Stiffleys (65 tons & over); Elevating Belt (Holland type); Heavy equipment robotics operator; Loader (360 degrees revolving Koehring Scooper or similar); Loaders (overhead & front-end, over 8 yds. to 10 yds.); Rubber-tired Scrapers (multiple engine with three or more scrapers); Shovels (3 yds. & over); Whirleys & Hammerheads, ALL

GROUP 8: Cranes (85 tons and over, and all climbing, overhead, rail and tower), all attachments including clamshell, dragline; Loaders (overhead and front-end, 10 yards and over); Helicopter Pilot

BOOM PAY: (All Cranes, Including Tower)  
180' to 250'      \$ .30 over scale  
Over 250'        \$ .60 over scale

NOTE: In computing the length of the boom on Tower Cranes, they shall be measured from the base of the Tower to the point of the boom

HAZMAT: Anyone working on HAZMAT jobs, working with supplied air

shall receive \$1.00 an hour above classification.

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ENGI0370G 06/01/1998

	Rates	Fringes
ADAMS, ASOTIN, BENTON, CHELAN (EAST OF THE 120TH MERIDIAN), COLUMBIA, DOUGLAS (EAST OF THE 120TH MERIDIAN), FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN (EAST OF THE 120TH MERIDIAN), PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN AND YAKIMA (EAST OF THE 120TH MERIDIAN) COUNTIES		

WORK PERFORMED ON HYDRAULIC DREDGES

GROUP 1:	23.28	5.40
GROUP 2:	23.64	5.40
GROUP 3:	23.67	5.40
GROUP 4:	24.05	5.40
GROUP 5:	23.10	5.40

GROUP 1: Assistant Mate (Deckhand) and Oiler  
GROUP 2: Assistant Engineer (Electric, Diesel, Steam, or  
Booster Pump); Mates and Boatmen  
GROUP 3: Engineer Welder  
GROUP 4: Leverman, Hydraulic  
GROUP 5: Maintenance

HEAVY WAGE RATES APPLIES TO CLAM SHELL DREDGE, HOE AND DIPPER,

SHOVELS AND SHOVEL ATTACHMENTS, CRANES AND BULLDOZERS.

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ENGI0612A 06/01/1998

	Rates	Fringes
LEWIS, PIERCE, PACIFIC (THAT PORTION WHICH LIES NORTH OF A PARALLEL LINE EXTENDED WEST FROM THE NORTHERN BOUNDARY OF WAHKAUKUM COUNTY TO THE SEA IN THE STATE OF WASHINGTON) AND THURSTON COUNTIES		

PROJECTS:

CATEGORY A PROJECTS (excludes Category B projects, as shown  
below)

POWER EQUIPMENT OPERATORS:

ZONE 1 (0-25 radius miles):

GROUP 1AAA	26.66	7.13
GROUP 1AA	26.16	7.13
GROUP 1A	25.66	7.13
GROUP 1	25.16	7.13
GROUP 2	24.72	7.13
GROUP 3	24.36	7.13

GROUP 4

22. 26

7. 13

ZONE 2 (26-45 radius miles) - Add \$.70 to Zone 1 rates

ZONE 3 (Over 45 radius miles) - Add \$1.00 to Zone 1 rates

BASEPOINTS: Tacoma, Olympia, and Centralia

#### POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-300 tons, or 300 ft of boom (including jib with attachments)

GROUP 1AA - Cranes 200 tons to 300 tons, or 250 ft of boom (including jib with attachments); Tower crane over 175 ft in height, base to boom

GROUP 1A - Crane 100 tons thru 199 tons, or 150 of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Shovel, excavator, backhoes-6 yds and over with attachments

GROUP 1 - Cableways; Cranes-45 tons thru 99 tons, under 150 ft of boom (including jib with attachments); Crane-overhead, bridge type - 45 tons thru 99 tons; Excavator, shovel, backhoes over 3 yards and under 6 yards; hard tail end dump articulating off-road equipment 45 yards and over; loader-overhead 6 yards to, but not including 8 yards; Mucking machine, mole, tunnel, drill and/or shield; Quad 9, HD 41, D-10; Remote control operator on rubber tired earth moving equipment; Rollagon; Scrapers-self-propelled-45 yds and over; Slipform pavers; Transporters-all track or truck type

GROUP 2 - Barrier machine (zipper); Batch Plant Operator-concrete; Bump cutter; Cranes-20 tons through 44 tons with attachments; Crane-overhead, bridge type-20 tons thru 44 tons;

Chipper, Concrete Pump-truck mounted with boom attachment; Crushers; Deck Engineer/Deck Winches (power); Drilling machine; Excavator, shovel, backhoe-3yards and under; Finishing machine, Bidwell, Gamaco and similar equipment; Guardrail punch; Horizontal/directional drill operator; Loaders, overhead under 6 yds.; Loaders, plant feed; Locomotive-all; Mechanics-all; Mixers, asphalt plant; Motor patrol graders-finishing; Piledriver (other than crane mount); Roto-mill, roto grinder; screedman, spreader, topside operator-Blaw Knox, Cedar Rapids, Jaeger, Caterpillar, Barbar Green; Scraper-self propelled, hard tail end dump, articulating off-road equipment under 45 yds.; Subgrader trimmer; Tractors, backhoes over 75 hp.; Transfer material

service machine-shuttle buggy, Blaw Knox-Roadtec; Truck Crane Oiler/driver-100 tons and over, Truck Mount Portable Conveyor; Yo Yo Pay dozer.

GROUP 3 - Conveyors; Cranes-thru 19 tons with attachments; Cranes-A-frame over 10 tons; Drill Oilers-Auger type, truck or crane mount; Dozers-D-9 and under; Forklifts-3000 lbs. and over with attachments; Horizontal/directional drill locator; Outside hoists-(elevators and manlifts), air tuggers, strato tower bucket elevators; Hydralifts/Boom Trucks-over 10 tons; Loaders-elevating type, belt; Motor patrol grader-nonfinishing; Plant Oiler-Asphalt, Crusher; Pumps, Concrete; Roller, plant mix or multi-lift materials; Saws-concrete; Scrapers-Concrete and Carry all; Trenching machines; Truck Crane Oiler/Driver-under 100 tons; Tractor, backhoe-under 75 hp

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor; Concrete Finish Machine-laser screed; Crane-A-Frame, 10 tons and under; Elevator and manlift-permanent and shaft type; Forklifts-under 3000 lbs. with attachments; Gradechecker, stakehop; Hydralifts, boom trucks, 10 tons and under; Oil distributors, blower distribution and mulch seeding operator; Pavement breaker; Posthole Digger-mechanical; Power plant; Pumps-Water; Roller-other than Plant Mix; Wheel Tractors, Farmall type; Shotcrete/Gunite Equipment Operator

CATEGORY B PROJECTS - 90% of the basic hourly rate for each group plus full fringe benefits applicable to Category A projects shall apply to the following projects: Reduced rates may be paid on the following:

1. Projects involving work on structures such as buildings and structures whose total value is less than \$1.5 million excluding mechanical, electrical, and utility portions of the contract.
2. Projects of less than \$1 million where no building is involved. Surfacing and paving included, but utilities excluded.
3. Marine projects (docts, wharfs, etc.) less than \$150,000

**WORK PERFORMED ON HYDRAULIC DREDGES:**

Total Project cost \$300,000 and over

GROUP 1	23.90	6.88
GROUP 2	23.98	6.88
GROUP 3	24.34	6.88
GROUP 4	24.39	6.88
GROUP 5	25.78	6.88
GROUP 6	23.90	6.88

GROUP 1: Assistant Mate (Deckhand)

GROUP 2: Oiler

GROUP 3: Assistant Engineer (Electric, Diesel, Steam

or Booster Pump); Mates and Boatmen  
 GROUP 4: Craneman, Engineer Welder  
 GROUP 5: Leverman, Hydraulic  
 GROUP 6: Maintenance

**Total Project Cost under \$300,000**

GROUP 1	21.51	6.88
GROUP 2	21.58	6.88
GROUP 3	21.91	6.88
GROUP 4	21.95	6.88
GROUP 5	23.20	6.88
GROUP 6	21.51	6.88

GROUP 1: Assistant Mate (Deckhand)  
 GROUP 2: Oiler  
 GROUP 3: Assistant Engineer (Electric, Diesel, Steam or  
 Booster Pump); Mates and Boatmen  
 GROUP 4: Craneman, Engineer Welder  
 GROUP 5: Leverman, Hydraulic  
 GROUP 6: Maintenance

**HEAVY WAGE RATES APPLIES TO CLAM SHEEL DREDGE, HOE AND DIPPER,  
 SHOVELS AND SHOVEL ATTACHMENTS, CRANES AND BULLDOZERS**

**HANDLING OF HAZARDOUS WASTE MATERIALS**

H-1 - When not outfitted with protective clothing of  
 level D equipment - Base wage rate  
 H-2 - Class "C" Suit - Base wage rate + \$.25 per hour  
 H-3 - Class "B" Suit - Base wage rate + \$.50 per hour  
 H-4 - Class "A" Suit - Base wage rate +\$.75 per hour

\* ENGI0701D 01/01/1999

**Rates Fringes**  
 CLARK, COWLITZ, KLICKITAT, PACIFIC (SOUTH), SKAMANIA, AND  
 WAHKIAKUM COUNTIES

**POWER EQUIPMENT OPERATORS (See Footnote A)**

**ZONE 1:**

GROUP 1	25.91	8.20
GROUP 2	25.00	8.20
GROUP 3	24.30	8.20
GROUP 4	23.83	8.20
GROUP 5	23.27	8.20
GROUP 6	21.10	8.20

**Zone Differential (add to Zone 1 rates):**

Zone 2 - \$1.50

**Zone 3 - 3.00**

**For the following metropolitan counties: MULTNOMAH; CLACKAMAS; MARION; WASHINGTON; YAMHILL; AND COLUMBIA; CLARK AND COWLITZ COUNTY, WASHINGTON WITH MODIFICATIONS AS INDICATED:**

All jobs or projects located in Multnomah, Clackamas and Marion counties, West of the western boundary of Mt. Hood National Forest and West of Mile Post 30 ON Interstate 84 and West of Mile Post 30 on State Highway 26 and West of Mile Post 30 on Highway 22 and all jobs located in Yamhill County, Washington County and Columbia County and all jobs or projects located in Clark and Cowlitz Counties, Washington except that portion of Cowlitz County in the Mt. St. Helens "Blast Zone" shall receive Zone I pay for all classifications.

All jobs or projects located in the area outside the identified boundary above, but less than 50 miles from the Portland City Hall shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the Portland City Hall, but outside the identified border above, shall receive Zone III pay for all classifications.

**For the following cities: ALBANY; COOS, BAY; EUGENE; GRANTS PASS; KLAMATH FALLS; MEDFORD; ROSEBURG**

All jobs or projects located within 30 miles of the respective city hall of the above mentioned cities shall receive Zone I pay for all classifications.

All jobs of projects located more than 30 miles and less than 50 miles from the respective city hall of the above mentioned cities shall receive Zone II pay for all classifications.

All jobs of projects located more than 50 miles from the respective city hall of the above mentioned cities shall receive Zone III pay for all classifications.

**POWER EQUIPMENT OPERATORS CLASSIFICATIONS**

**GROUP 1: CONCRETE: Batch Plant and/or Wet Mix Operator, three units or more; CRANE: Crane Operator, over 200 tons; Whirley Operator 90 tons and over; Helicopter Operators, when used in erecting work; Floating Crane, 150 tons but less than 250 tons; Lattice Boom Crane - 200 tons and over, Boom 201' through 280'; FLOATING EQUIPMENT: Floating Crane, 250 tons and over**

**GROUP 2: ASPHALT:** Asphalt Plant Operator (any type); Roto-mill, pavement profiler, operator, six foot lateral cut and over; **BLADE:** Auto Grader or "Trimmer" Operator (Grade Checker required); **BULLDOZERS:** Tandem bulldozer operator, quad-nine and similar type; D-11; Tandem Bulldozer Operator, Quad-nine and similar type; **CONCRETE:** Batch Plant and/or Wet Mix Operator, one and two drum; Automatic Concrete Slip Form Paver Operator; Concrete Canal Line Operator; Concrete Profiler, Diamond Head;

**CRANE:** Cableway Operator, 25 tons and over; Crane Operator, over 40 tons and including 100 tons; Crane Operator, over 100 tons and including 200; Tower Crane Operator, over 80 tons and including 150 tons; Whirley Operator - under 90 tons; Lattice Boom Crane - 90 through 199 tons, Boom = 150' through 200'; **CRUSHER:** Crusher Plant Operator; **FLOATING EQUIPMENT:** Floating Clamshell, etc. Operator, 3cu. yds. and over; Floating Crane (derrick barge) Operator, 30 tons but less than 80 tons; Floating Crane (derrick barge) Operator, 80 ton but less than 150 ton; **LOADERS:** Loader Operator, 6 cu. yds. but less than 12 cu. yds.; Loader Operator, 12 cu. yds. and over; **REMOTE CONTROL:** Remote controlled earth-moving equipment (no one operator shall operate more than two pieces of earth-moving equipment at one time); **RUBBER-TIRED SCRAPERS:** Rubber-tired Scraper Operator, with tandem scrapers, multi-engine; **SHOVEL, DRAGLINE, CLAMSHELL, BACKHOE, SKOOPER, OPERATOR:** Shovel, etc., 3 cu. yds., but less than 5 cu. yds.; Shovel, etc., 5 cu. yds. and over; **TRENCH MACHINE:** Wheel Excavator, under 750 cu. yds. per hour (Grade Oiler required); Canal Trimmer (Grade Oiler required); Wheel Excavator, over 750 cu. yds. per hour (two Operators and at least one Grade Oiler required); Band Wagon (in conjunction with wheel excavator); **UNDERWATER EQUIPMENT:** Underwater Equipment Operator, remote or otherwise, when used in construction work.

**GROUP 3: CRANES:** Lattice Boom Crane - 50 through 89 tons; **FORKLIFT:** Rock Hound Operator; **LOADERS:** Loader Operator, 4 cu. yds. but less than 6 cu. yds.; Rubber-tired **RUBBER-TIRED SCRAPERS:** Scraper Operator, with tandem scrapers; Self-loading, paddle wheel, auger type, finish and/or 2 or more units

**GROUP 4: ASPHALT:** Screed Operator; Asphalt Paver Operator (Screed man required); Diesel-Electric engineer, Plant; Roto-Mill, pavement profiler, operator, under six foot lateral cut; **BLADE:** Blade Operator, externally controlled by electronic, mechanical hydraulic means; Blade operator, multi-engine; **BULLDOZERS:** Bulldozer Operator; Drill Cat Operator; Side-boom Operator; Bulldozer Operator, twin engine (TC 12 and similar type, D-10); Cable-Plow Operator (any type); **CLEARING:** Log Skidders; Chippers; Incinerator; Stump Splitter (loader mounted or similar type); Compactor Operator, with blade; Compactor Operator, multi-engine; **CONCRETE:** Mixer Mobile Operator; Screed Operator; Concrete Cooling Machine Operator; Concrete Paving Road Mixer; Concrete Breaker; Reinforced Tank Banding Machine (K-17 or

similar types); CRANE: Chicago boom and similar types; Lift Slab Machine Operator; Boom type lifting device, 5 ton capacity or less; Cherry Picker or similar type crane-hoist, 5 ton capacity or less; Crane Operator, under 25 ton (except for rough terrain), Hoist Operator, two drum; Hoist Operator, three or more drums; Derrick Operator, under 100 ton; Hoist Operator, stiff leg, guy derrick or similar type, 50 ton and over; Cableway Operator, up to twenty-five ton; Crane Operator, over twenty-five ton and including forty ton; Bridge Crane Operator; Locomotive, Gantry, Overhead; Lattice Boom Crane - 25 through 49 tons; CRUSHER: Generator Operator; Diesel-Electric Engineer; Grizzley Operator; DRILLING: Drill Doctor; Boring Machine Operator; Driller-Percussion, Diamond, Core, Cable, Rotary and similar type; Cat

Drill (John Henry); FLOATING EQUIPMENT: Diesel-electric Engineer; Jack Operator, elevating barges, Barge Operator, self-unloading; Piledriver Operator (not crane type) (Deckhand required); Floating Clamshell, etc. Operator, under 3 cu. yds. (Fireman or Diesel-Electric Engineer required); Floating Crane (derrick barge) Operator, less than 30 tons; GENERATORS: Generator Operator; Diesel-electric Engineer required); GUARDRAIL EQUIPMENT: Guardrail Punch Operator (all types); Guardrail auger Operator (all types); Combination Guardrail machines, i. e. punch, auger, etc.; HEATING PLANT: Surface Heater and Planer Operator; HYDRAULIC HOES: Hydraulic Backhoe Operator, Track Type 3/8 cu. yd. takes shovel Classif. rate); LOADERS: Belt Loaders, Kolman and Ko Cal types; Loaders Operator, front end and overhead, 2-1/2 cu. yds. and under 4 cu. yds.; Elevating Loader Operator, Athey and asimilar types; Elevating Grader Operator, operated by Tractor Operator, sierra, Euclid or similar types; PILEDRIVERS: Hammer Operator; Piledriver Operator (not crane type); Pipe Cleaning Machine Operator; Pipe Doping Machine Operator; PIPELINE, SEWER WATER: Pipe Bending Machine Operator; Pipe Wrapping Machine Operator; Boring Machine Operator; Back Filling Machine Operator; REPAIRMEN, HEAVY DUTY: Diesel-Electric Engineer (Plant or Floating); Bolt Treading Machine Operator; Drill Doctor (bit grinder); H. D. Mechanic; H. D. Welder; Machine Tool Operator; Combination H. D. Mechanic-Welder, when dispatched and/or when required to do both; Welder-Certified, when dispatched and/or required; RUBBER-TIRED SCRAPERS: Rubber-tired Scraper Operator, single engine, single scraper; Self-loading, paddle wheel, auger type under 15 cu. yds.; rubber-tired Scraper Operator, twin engine; Rubber-tired Scraper Operator, with push-pull attachments; Self-loading, paddle wheel, auger type 15 cu. yds. and over, single engine; SHOVEL, DRAGLINE, CLAMSHELL, BACKHOE, SKOOPER OPERATOR: Diesel-Electric Engineer; Stationary Drag Scraper Operator; Shovel, Dragline, Clamshell, Hoe, etc., Operator, under 1 cu. yd.; Shovel, etc., 1 cu. yd. and less than 3 cu. yds.; Grade-all Operator, under 1 cu. yd.; Grade-all 1 cu. yd. and over; SURFACING (BASE) MATERIALS: Blade Mounted Spreaders, Ulrich and similar types; TRACTOR-RUBBER TIRED: Tractor Operator, rubber-tired, over 50 H. P. Flywheel; Tractor Operator, with boom attachment; Rubber-tired Dozers and Pushers (Michigan, Cat, Hough type); TRENCHING MACHINE: Trenching Machine Operator, maximum digging capacity over 3 ft. depth (Grade Oiler required); Back Filling Machine Operator; TUNNEL:

Mucking Machine Operator; Shield Operator; Boring Machine Operator

GROUP 5: ASPHALT: Extrusion Machine Operator; Roller Operator (any asphalt mix); Asphalt Burner and reconditioner Operator (any type), 84; roto-mill, Pavement Profiler, ground man.; COMPRESSORS: Compressor Operator (any power), over 1,250 cu. ft. total capacity; COMPACTORS: Compactor Operator, including vibratory; Wagner Pactor Operator or similar type (without blade); CONCRETE: Combination mixer and Compressor Operator, gunite work; Concrete Batch Plant Quality Control Operator; Beltcrete Operator; Pumpcrete Operator (any type) Pavement Grinder and/or Grooving Machine Operator (riding type); Cement Pump Operator, Fuller-Kenyon and similar; Concrete Pump Operator;

Grouting Machine Operator; Concrete Mixer Operator, single drum, under five bag capacity and over; Cast place pipe laying machine; Maginnis Internal Full Slab Vibrator Operator; Concrete Finishing machine Operator, Clary, Johnson, Bidwell, Burgess bridge deck or similar type; Curb Machine Operator, mechanical Berm, Curb and/or Curb and Gutter; Concrete Joint Machine Operator; Concrete Planer Operator; Tower Mobile Operator; Power Jumbo Operator setting slip forms; Concrete Paving Machine Operator; Concrete Finishing Machine Operator; Concrete Spreader Operator; CRANE: Helicopter Hoist Operator; Hoist Operator, single drum; Elevator Operator; A-frame Truck Operator, Double drum; Boom Truck Operator Hydraulic Boom Truck, Pittman; DRILLING: Churn Drill and earth Boring Machine Operator; FLOATING EQUIPMENT: Fireman; FORKLIFT: Lull Hi-Lift Operator or similar type; Fork Lift, over 5 ton; HYDRAULIC HOES: Hydraulic Backhoe Operator, wheel type 3/8 cu. yd and under with or without front end attachment 2-1/2 cu. yds. and under (Ford, John Deere, Case, Type); LOADERS: Loaders, rubber-tired type, 2-1/2 cu. yds. and under; Elevating Grader Operator, Tractor Towed requiring Operator or Grader; OILERS: Service Oiler (Greaser); PIPELINE, SEWER WATER: Hydra Hammer or similar types; Pavement Breaker Operator; RAILROAD EQUIPMENT: Locomotive Operator, under 40 tons; Ballast Regulator Operator; Ballast Tamper Multi-Purpose Operator; Track Liner Operator; Tie Spacer Operator; Shuttle Car Operator; Locomotive Operator, 40 tons and over; SURFACING (BASE) MATERIAL: Roller Operator, Oiling, C. T. B.; Rock Spreaders self-propelled; Pulva-mixer or similar types; Chip Spreading Machine Operator Lime Spreading Operator, construction job site; SWEEPERS: Sweeper Operator (Wayne Tractor Operator, rubber-tired, 50 H. P. Flywheel and under; TRENCHING: Trench Machine Operator, maximum digging capacity 3 ft. depth

GROUP 6: ASPHALT: Plant Oiler; Plant Fireman; Pugmill Operator (any type); Truck mounted asphalt spreader, with screed; BLADE: Blade Operator, pulled type; COMPRESSORS: Compressor Operator (any power), under 1,250 cu. ft. total capacity; CONCRETE: Plant Oiler, Assistant Conveyor Operator; Conveyor Operator; Mixer Box Operator (C. T. B., dry batch, etc.); Cement Hog Operator; Concrete Saw Operator; Concrete Curing Machine Operator (riding type);

Wire Mat or Brooming Machine Operator; CRANE: Oiler; Truck Crane Oiler-Driver, 25 tons capacity or over; Fireman, all equipment; A-frame Truck Operator, single drum; Tugger or Coffin Type Hoist Operator; CRUSHER: Crusher Oiler; Crusher Feeder; DRILLING: Drill Tender; Auger Oiler; FLOATING EQUIPMENT: Deckhand; Boatman; FORKLIFT: Self-propelled Scaffolding Operator, construction job site (excluding working platform); Fork Lift or Lumber Stacker Operator, construction job site; GUARDRAIL EQUIPMENT: Oiler, auger Oiler; Oiler, combination guardrail machines; Guardrail Punch Oiler; HEATING PLANT: Temporary Heating Plant Operator; LOADERS: Bucket Elevator Loader Operator, Barber-Greene and similar types; Bobcat, Skid Steer - Under 1 yd; OILERS: Oiler; Guardrail Punch Oiler; Truck Crane Oiler-Driver, 25 ton or over; Auger Oiler; Grade Oiler, required to check grade; Grade Checker; Tar Pot Fireman; PIPELINE SEWER WATER: Tar Pot Fireman (power agitated); Hydraulic Pipe Press Operator; PUMPS: Pump Operator, under 4"; Pump Operator (any power), 4" and over; Hydrostatic

Pump Operator; RAILROAD EQUIPMENT: Brakeman; Oiler; Switchman; Motorman; Ballast Jack Tamper Operator; REPAIRMAN HEAVY DUTY: Parts Man (Tool Room); SHOVEL, DRAGLINE, CLAMSHELL, BACKHOE, SKOOPER OPERATORS: Oiler; Grade Oiler (required to check grade); Grade Checker; Fireman; Signaller; Bell Boy, phones, etc., Operator; Helicopter Radioman (ground); SURFACING (BASE) MATERIAL: Roller Operator, grading of base rock (not asphalt); Tamping Machine Operator, mechanical, self-propelled; Hydrographic Seeder Machine Operator, staw, pulp or seed; SWEEPERS: Broom Operator, self-propelled, construction job site; TRENCHING: Oiler; Grade Oiler (required to check grade); TUNNEL: Conveyor Operator (any type); air Filtration Equipment Operator; Motormen (dinkey); Oiler; WELDING MACHINES: Welding Machine Operator

FOOTNOTE A: HANDLING OF HAZARDOUS WASTE MATERIALS: Personnel in all craft classifications subject to working inside a federally designated hazardous perimeter shall be eligible for compensation in accordance with the following group schedule relative to the level of hazardous waste as outline in the specific hazardous waste project site safety plan.

H-1 Base wage rate when on a hazardous waste site when not outfitted with protective clothing.

H-2 Class "C" Suit - Basic hourly wage rate plus \$1.00 per hour, fringes plus \$0.15.

H-3 Class "B" Suit - Basic hourly wage rate plus \$1.50 per hour, fringes plus \$0.15.

H-4 Class "A" Suit - Basic hourly wage rate plus \$2.00 per hour, fringes plus \$0.15.

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ENGI0701E 06/01/1998

	Rates	Fringes
CLARK, COWLITZ, KLICKITAT, PACIFIC (SOUTH), SKAMANIA, AND WAHKIAKUM COUNTIES		

**DREDGING:**

**ZONE A**

LEVERMAN, HYDRAULIC	27.45	7.25
LEVERMAN, DIPPER, FLOATING CLAMSHELL	27.45	7.25
ASSISTANT ENGINEER	26.62	7.25
TENDERMAN	26.01	7.25
ASSISTANT MATE	23.78	7.25

**ZONE B**

LEVERMAN, HYDRAULIC	29.45	7.25
LEVERMAN, DIPPER, FLOATING CLAMSHELL	29.45	7.25
ASSISTANT ENGINEER	28.62	7.25
TENDERMAN	28.01	7.25
ASSISTANT MATE	25.78	7.25

**ZONE C**

LEVERMAN, HYDRAULIC	30.45	7.25
LEVERMAN, DIPPER, FLOATING CLAMSHELL	30.45	7.25
ASSISTANT ENGINEER	29.62	7.25
TENDERMAN	29.01	7.25
ASSISTANT MATE	26.78	7.25

**ZONE DESCRIPTION FOR DREDGING:**

ZONE A - All jobs or projects located within 30 road miles of Portland City Hall.

ZONE B - Over 30-50 road miles from Portland City Hall.

ZONE C - Over 50 road miles from Portland City Hall.

\*All jobs or projects shall be computed from the city hall by the shortest route to the geographical center of the project.

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\* IRON0014F 10/05/1998

	Rates	Fringes
ADAMS, ASOTIN, BENTON, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN, PEND ORIELLE, SPOKANE, STEVENS, WALLA WALLA AND WHITMAN COUNTIES		

IRONWORKERS	22.60	10.17
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IRON0029I 07/01/1998

	Rates	Fringes
CLARK, CLALLAM, CHELAN, COWLITZ, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITTITAS, KLUCKITAT, KITSAP, LEWIS, MASON, PACIFIC, PIERCE, SKAGIT, SKAMANIA, SNOHOMISH, THURSTON, WAHKAIAKUM, WHATCOM AND YAKIMA COUNTIES		

IRONWORKERS	22.90	10.17
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LAB00001D 06/01/1998

	Rates	Fringes
CHELAN, DOUGLAS (WEST OF THE 120TH MERIDIAN), KITTITAS AND YAKIMA COUNTIES		

LABORERS:

ZONE 1:

GROUP 1	13.44	5.19
GROUP 2	15.76	5.19
GROUP 3	17.48	5.19
GROUP 4	17.96	5.19
GROUP 5	18.32	5.19

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):

ZONE 2 - \$ .70

ZONE 3 - \$1.00

BASE POINTS: CHELAN, SUNNYSIDE, WENATCHEE,  
AND YAKIMA

ZONE 1 - Projects within 25 radius miles of the respective city  
hall

ZONE 2 - More than 25 but less than 45 radius miles from the  
respective city hall

ZONE 3 - More than 45 radius miles from the respective city hall

CALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS,  
MASON, PACIFIC (NORTH OF STRAIGHT LINE MADE BY EXTENDING THE  
NORTH BOUNDARY WAHKAIAKUM COUNTY WEST TO THE PACIFIC OCEAN),  
PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM  
COUNTIES

LABORERS:

ZONE 1:

GROUP 1	14.36	5.19
GROUP 2	16.68	5.19

GROUP 3	21.36	5.19
GROUP 4	21.84	5.19
GROUP 5	22.20	5.19

**ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):**

ZONE 2 - \$ .70

ZONE 3 - \$1.00

**BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT,  
SEATTLE, KENT, TACOMA, OLYMPIA,  
CENTRALIA, ABERDEEN, SHELTON, PT.  
TOWNSEND, PT. ANGELES, AND BREMERTON**

**ZONE 1 - Projects within 25 radius miles of the respective city hall**

**ZONE 2 - More than 25 but less than 45 radius miles from the respective city hall**

**ZONE 3 - More than 45 radius miles from the respective city hall**

**LABORERS CLASSIFICATIONS**

**GROUP 1: Landscaping and Planting; Watchman; Window Washer/Cleaner (detail clean-up, such as but not limited to cleaning floors, ceilings, walls, windows, etc., prior to final acceptance by the owner)**

**GROUP 2: Batch Weighman; Crusher Feeder; Fence Laborer; Flagman; Pilot Car**

**GROUP 3: General Laborer; Air, Gas, or Electric Vibrating Screed; Asbestos Abatement Laborer; Ballast Regulator Machine; Brush Cutter; Brush Hog Feeder; Burner; Carpenter Tender; Cement Finisher Tender; Change House or Dry Shack; Chipping Gun (under 30 lbs.); Choker Setter; Chuck Tender; Clean-up Laborer; Concrete Form Stripper; Curing Laborer; Demolition (wrecking and moving**

**including charred material); Ditch Digger; Dump Person; Fine Graders; Firewatch; Form Setter; Gabian Basket Builders; Grout Machine Tender; Grinders; Guardrail Erector; Hazardous Waste Worker (Level C); Maintenance Person; Material Yard Person; Pot Tender; Rip Rap Person; Riggers; Scale Person; Sloper Sprayer; Signal Person; Stock Piler; Stake Hopper; Toolroom Man (at job site); Topper-Tailer; Track Laborer; Truck Spotter; Vinyl Seamer**

**GROUP 4: Cement Dumper-Paving; Chipping Gun (over 30 lbs.); Clary Power Spreader; Concrete Dumper/Chute Operator; Concrete Saw Operator; Drill Operator (hydraulic, diamond, airtrac); Faller and Bucker Chain Saw; Grade Checker and Transit Person;**

Groutmen (pressure) including post tension beams; Hazardous Waste Worker (Level B); High Scaler; Jackhammer; Laserbeam Operator; Manhole Builder-Mudman; Mortarman and Hodcarrier; Nozzlemán (concrete pump, green cutter when using combination of high pressure air and water on concrete and rock, sandblast, gunité, shotcrete, water blaster, vacuum blaster); Pavement Breaker; Pipe Layer and Caulker; Pipe Pot Tender; Pipe Reliner (not insert type); Pipe Wrapper; Power Jacks; Railroad Spike Puller-Power; Raker-Asphalt; Rivet Buster; Rodder; Sloper (over 20'); Spreader (concrete); Tamper and Similar electric, air and glas operated tool; Timber Person-sewer (lagger shorer and cribber); Track Liner Power; Tugger Operator; Vibrator; Well Point Laborer

GROUP 5: Caisson Worker; Miner; Powderman; Re-Timberman; Hazardous Waste Worker (Level A).

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LAB00238E 06/01/1998

	Rates	Fringes
ADAMS, ASOTIN, BENTON, COLUMBIA, DOUGLAS (EAST OF THE 120TH MERIDIAN), FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN, PEND OREILLE, STEVENS, SPOKANE, WALLA WALLA AND WHITMAN COUNTIES		

LABORERS:

ZONE 1:

GROUP 1	17.01	4.39
GROUP 2	19.05	4.39
GROUP 3	19.31	4.39
GROUP 4	19.57	4.39
GROUP 5	19.84	4.39
GROUP 6	21.17	4.39

Zone Differential (Add to Zone 1 rate): \$2.00

BASE POINTS: Spokane, Moses Lake, Pasco, Lewiston

Zone 1: 0-45 radius miles from the main post office.

Zone 2: 45 radius miles and over from the main post office.

#### LABORERS CLASSIFICATIONS

GROUP 1: Flagman; Landscape Laborer; Scaleman; Traffic Control Maintenance Laborer (to include erection and maintenance of

barricades, signs and relief of flagperson); Window Washer/Cleaner (detail cleanup, such as, but not limited to cleaning floors, ceilings, walls, windows, etc. prior to final acceptance by the owner)

**GROUP 2:** Asbestos Abatement Worker; Brush Hog Feeder; Carpenter Tender; Cement Handler; Clean-up Laborer; Concrete Crewman (to include stripping of forms, hand operating jacks on slip form construction, application of concrete curing compounds, pumpcrete machine, signaling, handling the nozzle of squeezecrete or similar machine, 6 inches and smaller); Confined Space Attendant; Concrete Signalman; Crusher Feeder; Demolition (to include clean-up, burning, loading, wrecking and salvage of all material); Dumpman; Fence Erector; Firewatch; Form Cleaning Machine Feeder, Stacker; General Laborer; Grout Machine Header Tender; Guard Rail (to include guard rails, guide and reference posts, sign posts, and right-of-way markers); Hazardous Waste Worker, Level D (no respirator is used and skin protection is minimal); Miner, Class "A" (to include all bull gang, concrete crewman, dumpman and pumpcrete crewman, including distributing pipe, assembly & dismantle, and nipper); Nipper; Riprap Man; Sandblast Tailhoseman; Scaffold Erector (wood or steel); Stake Jumper; Structural Mover (to include separating foundation, preparation, cribbing, shoring, jacking and unloading of structures); Tailhoseman (water nozzle); Timber Bucker and Faller (by hand); Track Laborer (RR); Truck Loader; Well-Point Man; All Other Work Classifications Not Specially Listed Shall Be Classified As General Laborer

**GROUP 3:** Asphalt Raker; Asphalt Roller, walking; Cement Finisher Tender; Concrete Saw, walking; Demolition Torch; Dope Pot Firemen, non-mechanical; Driller Tender (when required to move and position machine); Form Setter, Paving; Grade Checker using level; Hazardous Waste Worker, Level C (uses a chemical "splash suit" and air purifying respirator); Jackhammer Operator; Miner, Class "B" (to include brakeman, finisher, vibrator, form setter); Nozzlemaster (to include squeeze and flo-crete nozzle); Nozzlemaster, water, air or steam; Pavement Breaker (under 90 lbs.); Pipelayer, corrugated metal culvert; Pipelayer, multi-plate; Pot Tender; Power Buggy Operator; Power Tool Operator, gas, electric, pneumatic; Railroad Equipment, power driven, except dual mobile power spiker or puller; Railroad Power Spiker or Puller, dual mobile; Rodder and Spreader; Tamper (to include operation of Barco, Essex and similar tampers); Trencher, Shawnee; Tugger Operator; Wagon Drills; Water Pipe Liner; Wheelbarrow (power driven)

**GROUP 4:** Air and Hydraulic Track Drill; Brush Machine (to include horizontal construction joint cleanup brush machine, power propelled); Caisson Worker, free air; Chain Saw Operator and Faller; Concrete Stack (to include laborers when laborers working on free standing concrete stacks for smoke or fume control above 40 feet high); Guniting (to include operation

of machine and nozzle); Hazardous Waste Worker, Level B (uses same respirator protection as Level A. A supplied air line is provided in conjunction with a chemical "splash suit"); High Scaler; Laser Beam Operator (to include grade checker and elevation control); Miner, Class C (to include miner, nozzle man for concrete, laser beam operator and rigger on tunnels); Monitor Operator (air track or similar mounting); Mortar Mixer; Nozzle man (to include jet blasting nozzle man, over 1,200 lbs., jet blast machine power propelled, sandblast nozzle); Pavement Breaker (90 lbs. and over); Pipelayer (to include working topman, caulker, collarman, jointer, mortarman, rigger, jacker, shorer, valve or meter installer); Pipe wrapper; Plasterer Tender; Vibrators (all)

GROUP 5 - Drills with Dual Masts; Hazardous Waste Worker, Level A (utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line); Miner Class "D", (to include raise and shaft miner, laser beam operator on riases and shafts)

GROUP 6 - Powderman

LAB00238G 06/01/1998

COUNTIES EAST OF THE 120TH MERIDIAN: ADAMS, ASOTIN, BENTON, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN, PEND OREILLE, STEVENS, SPOKANE, WALLA WALLA, WHITMAN

	Rates	Fringes
HOD CARRIERS	19. 71	4. 39

LAB00335A 06/01/1998

CLARK, COWLITZ, KLICKITAT, PACIFIC (SOUTH OF A STRAIGHT LINE MADE BY EXTENDING THE NORTH BOUNDARY LINE OF WAHKIAKUM COUNTY WEST TO THE PACIFIC OCEAN), SKAMANIA AND WAHKIAKUM COUNTIES

ZONE 1:

LABORERS:

	Rates	Fringes
GROUP 1	20. 47	6. 14
GROUP 2	20. 87	6. 14
GROUP 3	21. 21	6. 14
GROUP 4	21. 49	6. 14
GROUP 5	18. 73	6. 14
GROUP 6	16. 63	6. 14
GROUP 7	14. 18	6. 14

Zone Differential (Add to Zone 1 rates):

Zone 2 \$ 0. 65

Zone 3 - 1.15  
Zone 4 - 1.70  
Zone 5 - 2.75

BASE POINTS: GOLDENDALE, LONGVIEW, AND VANCOUVER

ZONE 1: Projects within 30 miles of the respective city all.

ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.

ZONE 3: More than 40 miles but less than 50 miles from the respective city hall.

ZONE 4: More than 50 miles but less than 80 miles from the respective city hall.

ZONE 5: More than 80 miles from the respective city hall.

#### LABORERS CLASSIFICATIONS

GROUP 1: Asphalt Plant Laborers; Asphalt Spreaders; Batch Weighman; Broomers; Brush Burners and Cutters; Car and Truck Loaders; Carpenter Tender; Change-House Man or Dry Shack Man; Choker Setter; Clean-up Laborers; Curing, Concrete; Demolition, Wrecking and Moving Laborers; Dumpers, road oiling crew; Dumpmen (for grading crew); Elevator Feeders; Guard Rail, Median Rail Reference Post, Guide Post, Right of Way Marker; Fine Graders; Fire Watch; Form Strippers (not swinging stages); General Laborers; Hazardous Waste Worker; Leverman or Aggregate Spreader (Flaherty and similar types); Loading Spotters; Material Yard Man (including electrical); Pittsburgh Chipper Operator or Similar Types; Railroad Track Laborers; Ribbon Setters (including steel forms); Rip Rap Man (hand placed); Road Pump Tender; Sewer Labor; Signalman; Skipman; Slopers; Spraymen; Stake Chaser; Stockpiler; Tie Back Shoring; Timber Faller and Bucker (hand labor); Toolroom Man (at job site); Tunnel Bullgang (above ground); Weight-Man-Crusher (aggregate when used)

GROUP 2: Applicator (including pot power tender for same), applying protective material by hand or nozzle on utility lines or storage tanks on project; Brush Cutters (power saw); Burners; Choker Splicer; Clary Power Spreader and similar types; Clean-up Nozzlemans-Green Cutter (concrete, rock, etc.); Concrete Power Buggyman; Concrete Laborer; Crusher Feeder; Demolition and Wrecking Charred Materials; Guniting Nozzlemans Tender; Guniting or Sand Blasting Pot Tender; Handlers or Mixers of all Materials of an irritating nature (including cement and lime); Tool Operators (includes but not limited to: Dry Pack Machine; Jackhammer; Chipping Guns; Paving Breakers); Pipe Doping and Wrapping; Post Hole Digger, air, gas or electric; Vibrating Screed; Tampers; Sand Blasting (Wet); Stake-Setter; Tunnel-Muckers, Brakemen, Concrete Crew, Bullgang (underground)

**GROUP 3: Asbestos Removal; Bit Grinder; Drill Doctor; Drill Operators, air tracks, cat drills, wagon drills, rubber-mounted drills, and other similar types including at crusher plants; Gunite Nozzlemans; High Scalers, Strippers and Drillers (covers work in swinging stages, chairs or belts, under extreme conditions unusual to normal drilling, blasting, barring-down, or sloping and stripping); Manhole Builder; Powdermen; Concrete Saw Operator; Powdermen; Power Saw Operators (Bucking and Falling); Pumpcrete Nozzlemen; Sand Blasting (Dry); Sewer Timberman; Track Liners, Anchor Machines, Ballast Regulators, Multiple Tampers, Power Jacks, Tugger Operator; Tunnel-Chuck Tenders, Nippers and Timbermen; Vibrator; Water Blaster**

**GROUP 4: Asphalt Raker; Concrete Saw Operator (walls); Concrete Nozzlemans; Grade Checker; Pipelayer; Laser Beam (pipelaying)- applicable when employee assigned to move, set up, align; Laser Beam; Tunnel Miners; Motorman-Dinky Locomotive-Tunnel; Powderman-Tunnel; Shield Operator-Tunnel**

**GROUP 5: Traffic Flaggers**

**GROUP 6: Fence Builders**

**GROUP 7: Landscaping or Planting Laborers**

**PAIN0005B 07/01/1991**

**STATEWIDE EXCEPT CLARK, COWLITZ, KLICKITAT, PACIFIC (SOUTH), SKAMANIA, AND WAHKIAKUM COUNTIES**

	Rates	Fringes
<b>STRIPERS</b>	<b>18.14</b>	<b>2.47</b>

**PAIN0005D 03/01/1998**

**CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC, PIERCE, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM COUNTIES**

	Rates	Fringes
<b>PAINTERS</b>	<b>21.11</b>	<b>3.52</b>

**PAIN0054D 07/01/1998**

**ADAMS, ASOTIN; BENTON AND FRANKLIN (EXCEPT HANFORD SITE); CHELAN, COLUMBIA, DOUGLAS, FERRY, GARFIELD, GRANT, KITTITAS, LINCOLN,**

OKANOGAN, PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA,  
WHITMAN AND YAKIMA COUNTIES

PAINTERS\*:

Brush, Roller, Striping, Steam-cleaning and Spray Application of Cold Tar Products, Epoxies, Polyure thanes, Acids, Radiation Resistant Material, Water and Sandblasting, Bridges, Towers, Tanks, Stacks, Steeples	18.80	3.67
TV Radio, Electrical Transmi ssi on Towers	19.65	3.67
Lead Abatement, Asbestos Abatement	20.39	3.67
	18.80	3.67

\*\$.70 shall be paid over and above the basic wage rates listed  
for work on swing stages and high work of over 30 feet.

PAIN0055C 11/01/1997

	Rates	Fringes
CLARK, COWLITZ, KLICKITAT, SKAMANIA, AND WAHKIAKUM COUNTIES		

INDUSTRIAL - ANY INDUSTRIAL FACILITY, MANUFACTURING PLANTS,  
PROCESS PLANTS, FACTORIES, PAPER MILLS AND ALUMINUM  
PLANTS

PAINTERS:

Brush & Roller	16.68	3.25
Spray and Sandblasting	17.28	3.25
High work - All work 60 ft. or higher	17.18	3.25

PAIN0055L 10/01/1993

	Rates	Fringes
CLARK, COWLITZ, KLICKITAT, SKAMANIA and WAHKIAKUM COUNTIES		

PAINTERS:

Highway and Parking Lot	18.14	2.37
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PLAS0072E 06/01/1998

	Rates	Fringes
ADAMS, ASOTIN, BENTON, CHELAN, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT, KITTITAS, LINCOLN, OKANOGAN, PEND		

OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN, AND  
YAKIMA COUNTIES

ZONE 1:  
CEMENT MASONS 21.04 5.14

Zone Differential (Add to Zone 1  
rate): Zone 2 - \$2.00

BASE POINTS: Spokane, Pasco, Moses Lake, Lewiston

Zone 1: 0 - 45 radius miles from the main post office  
Zone 2: Over 45 radius miles from the main post office

PLAS0528A 06/01/1998

Rates Fringes  
CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS,  
MASON, PACIFIC (NORTH), PIERCE, SAN JUAN, SKAGIT, SNOHOMISH,  
THURSTON, AND WHATCOM COUNTIES

CEMENT MASON	23.80	7.89
COMPOSITION, COLOR MASTIC, TROWEL MACHINE, GRINDER, POWER TOOLS, GUNNITE NOZZLE	24.05	7.89

PLAS0555B 06/01/1998

Rates Fringes  
CLARK, COWLITZ, KLICKITAT, PACIFIC (SOUTH), SKAMANIA, AND  
WAHKIAKUM COUNTIES

ZONE 1:

CEMENT MASONS	22.81	7.00
COMPOSITION WORKERS AND POWER MACHINERY OPERATORS	23.22	7.00
CEMENT MASONS ON SUSPENDED, SWINGING AND/OR HANGING SCAFFOLD	23.22	7.00
CEMENT MASONS DOING BOTH COMPOSITION/POWER MACHINERY AND SUSPENDED/HANGING SCAFFOLD	23.64	7.00

Zone Differential (Add To Zone 1 Rates):  
Zone 2 - \$0.65

Zone 3 - 1.15  
 Zone 4 - 1.70  
 Zone 5 - 2.75

BASE POINTS: BEND, CORVALLIS, EUGENE, LONGVIEW, MEDFORD,  
 PORTLAND, SALEM, THE DALLES, VANCOUVER

ZONE 1: Projects within 30 miles of the respective city hall  
 ZONE 2: More than 30 miles but less than 40 miles from the  
 respective city hall.  
 ZONE 3: More than 40 miles but less than 50 miles from the  
 respective city hall.  
 ZONE 4: More than 50 miles but less than 80 miles from the  
 respective city hall.  
 ZONE 5: More than 80 miles from the respective city hall

PLUM0032B 06/01/1998  
 CLALLAM, KING AND JEFFERSON COUNTIES

	Rates	Fringes
PLUMBERS AND PIPEFITTERS	29.48	10.08

PLUM0032D 06/01/1998  
 CHELAN, KITTITAS (NORTHERN TIP), DOUGLAS (NORTH), AND OKANOGAN  
 (NORTH) COUNTIES

	Rates	Fringes
PLUMBERS AND PIPEFITTERS	23.47	8.67

PLUM0040B 06/01/1996  
 WHATCOM COUNTY

	Rates	Fringes
PLUMBERS AND STEAMFITTERS Plumbing projects		
over \$3,000,000 Plumbing projects	27.04	7.81
\$3,000,000 and under	24.98	7.81

PLUM0044C 06/01/1998  
 ADAMS (NORTHERN PART), ASOTIN (CLARKSTON ONLY), FERRY (EASTERN

	Rates	Fringes
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PART), LINCOLN (EASTERN PART), PEND ORIELLE, STEVENS, SPOKANE,  
AND WHITMAN COUNTIES

PLUMBERS AND PIPEFITTERS	26.81	8.34
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PLUMD082A 06/01/1997

	Rates	Fringes
GRAYS HARBOR, LEWIS, MASON (EXCLUDING NE SECTION), AND PACIFIC PIERCE AND THURSTON COUNTIES		

PLUMBERS AND PIPEFITTERS	25.72	9.00
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CLARK (NORTHERN TIP INCLUDING WOODLAND), COWLITZ, SKAMANIA  
AND WAHKIAKUM COUNTIES

PLUMBERS AND PIPEFITTERS	24.79	9.00
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PLUMD265C 06/01/1997

	Rates	Fringes
ISLAND, SKAGIT, SNOHOMISH, AND SAN JUAN COUNTIES		

PLUMBERS AND PIPEFITTERS	28.14	9.39
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PLUMD290K 10/01/1998

	Rates	Fringes
CLARK (ALL EXCLUDING NORTHERN TIP INCLUDING CITY OF WOODLAND)		

PLUMBERS AND PIPEFITTERS	27.72	8.90
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PLUMD598E 06/01/1998

	Rates	Fringes
ADAMS (SOUTHERN PART), ASOTIN (EXCLUDING THE CITY OF CLARKSTON), BENTON, COLUMBIA, DOUGLAS (EASTERN HALF), FERRY (WESTERN PART), FRANKLIN, GARFIELD, GRANT, KITTITAS (ALL BUT NORTHERN TIP), KLIICKITAT, LINCOLN (WESTERN PART), OKANOGAN (EASTERN), WALLA WALLA AND YAKIMA COUNTIES		

PLUMBERS	27.80	9.60
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PLUMD631A 06/01/1997

	Rates	Fringes
MASON (NE SECTION),		
AND KITSAP COUNTIES		

**PLUMBERS/PIPEFITTERS:**

All new construction, additions, and remodeling of commercial building projects such as: cocktail lounges and taverns, professional buildings, medical clinics, retail stores, hotels and motels, restaurants and fast food types, gasoline service stations, and car washes where the plumbing and mechanical cost of the project is less than \$100,000

14.55	7.98
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All other work where the plumbing and mechanical cost of the project is \$100,000 and over

20.78	12.28
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TEAMD037C 06/01/1998

	Rates	Fringes
CLARK, COWLITZ, KLUCKITAT, PACIFIC (South of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean), SKAMANIA, AND WAHAKI AKUM COUNTIES		

**TRUCK DRIVERS**

**ZONE 1:**

GROUP 1	21.97	7.02
GROUP 2	22.09	7.02
GROUP 3	22.22	7.02
GROUP 4	22.47	7.02
GROUP 5	22.69	7.02
GROUP 6	22.84	7.02
GROUP 7	23.04	7.02

**Zone Differential (Add to Zone 1 Rates):**

Zone 2 - \$0.65  
 Zone 3 - 1.15  
 Zone 4 - 1.70  
 Zone 5 - 2.75

**BASE POINTS: ASTORIA, THE DALLES, LONGVIEW AND VANCOUVER**

- ZONE 1:** Projects within 30 miles of the respective city hall.  
**ZONE 2:** More than 30 miles but less than 40 miles from the respective city hall.  
**ZONE 3:** More than 40 miles but less than 50 miles from the respective city hall.  
**ZONE 4:** More than 50 miles but less than 80 miles from the respective city hall.  
**ZONE 5:** More than 80 miles from the respective city hall.

#### **TRUCK DRIVERS CLASSIFICATIONS**

**GROUP 1:** Battery Rebuilders; Bus or Manhaul Driver; Concrete Buggies (power operated); Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations there of: up to and including 10 cu. yds., Lift Jitneys, Fork Lifts (all sizes in loading, unloading and transporting material on job site); Loader and/or Leverman on Concrete Dry Batch Plant (manually operated); Pilot Car; Solo Flat Bed and misc. Body Trucks, 0 - 10 tons; Truck Tender; Truck Mechanic Tender; Water Wagons (rated capacity) up to 3,000 gallons; Transit Mix and Wet or Dry Mix - 5 cu. yds. and under. "A" Frame or Hydra-lift Truck with load bearing surface; Lubrication Man, Fuel Truck Driver, Tireman, Wash Rack, Steam Cleaner or combinations; Team Driver; Slurry Truck Driver or Leverman; Tireman

**GROUP 2:** Flaherty Spreader Driver or Leverman; Lowbed Equipment, Flat Bed Semi-trailer, Truck and Trailers or doubles transporting equipment or wet or dry materials; Lumber Carrier Driver - Straddle Carrier (used in loading, unloading and transporting of materials on job site); Oil Distributor Driver or Leverman; Water Wagons (rated capacity) over 3,000 to 5,000 gallons; Dumpsters or similar equipment, all sizes; Transit Mix and Wet or Dry Trucks, over 5 cu. yds, and including 7 cu. yds

**GROUP 3:** Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 10 cu. yds. and including 30 cu. yds.; Transit Mix and Wet or Dry Mix Trucks, over 7 cu. yds. and including 11 cu. yds.; Truck Mechanic-Welder-Body Repairman; Water Wagons (rated capacity) over 5,000 to 10,000 gallons

**GROUP 4:** Dump Trucks, side, end and bottom cumps, including Semi-Trucks and Trains or combinations thereof: over 30 cu. yds. and including 50 cu. yds.; Transit Mix and Wet or Dry Mix Trucks, over 11 cu. yds. and including 15 cu. yds.; Water Wagon (rated capacity) over 10,000 gallons to 15,000 gallons

**GROUP 5:** Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 50 cu. yds. and including 60 cu. yds.

GROUP 6: Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains of combinations thereof: over 60 cu. yds. and including 80 cu. yds.

GROUP 7: Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 80 cu. yds. and including 100 cu. yds.

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TEAM0174A 06/01/1998

Rates                      Fringes

CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC (North of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean), PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM COUNTIES

TRUCK DRIVERS;

GROUP 1:	22.45	7.75
GROUP 2:	21.87	7.75
GROUP 3:	19.93	7.75
GROUP 4:	16.30	7.75
GROUP 5:	21.62	7.75

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1 - "A-frame or Hydralift" trucks and Boom trucks or similar equipment when "A" frame or "Hydralift" and Boom truck or similar equipment is used; Buggymobile; Bulk Cement Tanker; Dumpsters and similar equipment, Tournorockers, Tournowagon, Tournotrailer, Cat DW series, Terra Cobra, Le Tourneau, Westinghouse, Athye Wagon, Euclid Two and Four-Wheeled power tractor with trailer and similar top-loaded equipment transporting material: Dump Trucks, side, end and bottom dump, including semi-trucks and trains or combinations thereof with 16 yards to 30 yards capacity: Over 30 yards \$.15 per hour additional for each 10 yard increment; Explosive Truck (field mix) and similar equipment; Hyster Operators (handling bulk loose aggregates); Lowbed and Heavy Duty Trailer; Road Oil Distributor Driver; Spreader, Flaherty Transit mix used exclusively in heavy construction; Water Wagon and Tank Truck-3,000 gallons and over capacity

GROUP 2 - Bulllifts, or similar equipment used in loading or unloading trucks, transporting materials on job site; Dumpsters, and similar equipment, Tournorockers, Tournowagon, Turnotrailer, Cat. D.W. Series, Terra Cobra, Le Tourneau, Westinghouse, Athye wagon, Euclid two and four-wheeled power tractor with trailer and similar top-loaded equipment transporting material: Dump trucks,

side, end and bottom dump, including semi-trucks and trains or combinations thereof with less than 16 yards capacity; Flatbed (Dual Rear Axle); Grease Truck, Fuel Truck, Greaser, Battery Service Man and/or Tire Service Man; Leverman and loader at bunkers and batch plants; Oil tank transport; Scissor truck; Slurry Truck; Sno-Go and similar equipment; Swampers; Straddler Carrier (Ross, Hyster) and similar equipment; Team Driver; Tractor (small, rubber-tired) (when used within Teamster jurisdiction); Vacuum truck; Water Wagon and Tank trucks-less than 3,000 gallons capacity; Winch Truck; Wrecker, Tow truck and similar equipment

GROUP 3 - Flatbed (single rear axle); Pickup Sweeper; Pickup Truck. (Adjust Group 3 upward by \$2.00 per hour for onsite work only)

GROUP 4 - Escort or Pilot Car

GROUP 5 - Mechanic

#### HAZMAT PROJECTS

Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium, in addition to the

classification working in as follows:

LEVEL C: +\$.25 per hour - This level uses an air purifying respirator or additional protective clothing.

LEVEL B: +\$.50 per hour - Uses same respirator protection as Level A. Supplied air line is provided in conjunction with a chemical "splash suit."

LEVEL A: +\$.75 per hour - This level utilizes a fully-encapsulated suit with a self-contained breathing apparatus or a supplied air line.

#### ZONE DIFFERENTIALS

Zone pay will be calculated from the city center of the following listed cities:

BELLINGHAM	CENTRALIA	RAYMOND	OLYMPIA
EVERETT	SHELTON	ANACORTES	BELLEVUE
SEATTLE	PORT ANGELES	MT. VERNON	KENT
TACOMA	PORT TOWNSEND	ABERDEEN	BREMERTON

TRAVEL - Zone A - 0 - 25 miles - Free Zone  
Zone B - 25 - 45 miles - \$ .70 per hour.  
Zone C - Over 45 miles - \$1.00 per hour.

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TEAM0760C 06/01/1998

Rates                      Fringes

COUNTIES FROM THE TOP OF THE CASCADE MOUNTAIN RANGE EAST: ADAMS,  
ASOTIN, BENTON, CHELAN, COLUMBIA, DOUGLAS, FERRY, FRANKLIN,  
GARFIELD, GRANT KITTITAS, LINCOLN, OKANOGAN, PEND OREILLE,  
SPOKANE, STEVENS, WALLA WALLA, AND WHITMAN COUNTIES

**TRUCK DRIVERS**

(ANYONE WORKING ON HAZMAT JOBS SEE FOOTNOTE A BELOW)

**ZONE 1: (INCLUDES ALL OF YAKIMA COUNTY)**

GROUP 1	17.11	7.06
GROUP 2	19.70	7.06
GROUP 3	19.81	7.06
GROUP 4	20.12	7.06
GROUP 5	20.22	7.06
GROUP 6	20.39	7.06
GROUP 7	20.90	7.06
GROUP 8	21.22	7.06

Zone Differential (Add to Zone 1  
rate: Zone 2 - \$2.00)

**BASE POINTS:** Spokane, Moses Lake, Pasco, Lewiston

Zone 1: 0-45 radius miles from the main post office.

Zone 2: 45 radius miles and over from the main post office

**TRUCK DRIVERS CLASSIFICATIONS**

**GROUP 1:** Escort Driver or Pilot Car; Employee Haul; Power Boat  
Hauling Employees or Material

**GROUP 2:** Fish Truck; Flat Bed Truck; Fork Lift (3000 lbs. and  
under); Leverperson (loading trucks at bunkers); Trailer Mounted  
Hydro Seeder and Mulcher; Seeder & Mulcher; Stationary Fuel  
Operator; Tractor (small, rubber-tired, pulling trailer or  
similar equipment)

**GROUP 3:** Auto Crane (2000 lbs. capacity); Buggy Mobile &  
Similar; Bulk Cement Tanks & Spreader; Dumptor (6 yds. & under);  
Flat Bed Truck with Hydraulic System; Fork Lift (3001-16,000  
lbs.); Fuel Truck Driver, Steamcleaner & Washer; Power Operated  
Sweeper; Rubber-tired Tunnel Jumbo; Scissors Truck; Slurry Truck

Driver; Straddle Carrier (Ross, Hyster, & similar); Tireperson; Transit Mixers & Truck Hauling Concrete (3 yd. to & including 6 yds.); Trucks, side, end, bottom & articulated end dump (3 yards to and including 6 yds.); Warehouseperson (to include shipping & receiving); Wrecker & Tow Truck

GROUP 4: A-Frame; Burner, Cutter, & Welder; Service Greaser; Trucks, side, end, bottom & articulated end dump (over 6 yards to and including 12 yds.); Truck Mounted Hydro Seeder; Warehouseperson; Water Tank truck (0-8,000 gallons)

GROUP 5: Dumptor (over 6 yds.); Lowboy (50 tons & under); Self-loading Roll Off; Semi-Truck & Trailer; Tractor with Steer Trailer; Transit Mixers and Trucks Hauling Concrete (over 6 yds. to and including 10 yds.); Trucks, side, end, bottom and end dump (over 12 yds. to & including 20 yds.); Truck-Mounted Crane (with load bearing surface either mounted or pulled, up to 14 ton); Vacuum Truck (super sucker, guzzler, etc.)

GROUP 6: Flaherty Spreader Box Driver; Flowboys; Fork Lift (over 16,000 lbs.); Dumps (Semi-end); Mechanic (Field); Semi-end Dumps; Transfer Truck & Trailer; Transit Mixers & Trucks Hauling Concrete (over 10 yds. to & including 20 yds.); Trucks, side, end, bottom and articulated end dump (over 20 yds. to & including 40 yds.); Truck and Pup; Tournarocker, DWs & similar with 2 or more 4 wheel-power tractor with trailer, gallonage or yardage scale, whichever is greater Water Tank Truck (8,001-14,000 gallons)

GROUP 7: Oil Distributor Driver; Stringer Truck (cable operated trailer); Transit Mixers & Trucks Hauling Concrete (over 20 yds.); Truck, side, end, bottom end dump (over 40 yds. to & including 100 yds.); Truck Mounted Crane (with load bearing surface either mounted or pulled (16 through 25 tons);

GROUP 8: Prime Movers and Stinger Truck; Trucks, side, end, bottom and articulated end dump (over 100 yds.); Helicopter Pilot Hauling Employees or Materials

Footnote A - Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium,

in addition to the classification working in as follows:

LEVEL C-D: - \$.50 PER HOUR (This is the lowest level of protection. This level may use an air purifying respirator or additional protective clothing.

LEVEL A-B: - \$1.00 PER HOUR (Uses supplied air in conjunction with a chemical splash suit or fully encapsulated

suit with a self-contained breathing apparatus.

NOTE: Trucks Pulling Equipment Trailers: shall receive \$.15/hour over applicable truck rate

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.  
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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)).

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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

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General Decision Number WA980013

Superseded General Decision No. WA970013

State: Washington

Construction Type:  
BUILDING

County(ies):  
YAKIMA

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	02/13/1998
1	06/12/1998
2	07/10/1998

COUNTY(ies):  
YAKIMA

ELEC0112J 03/16/1996

	Rates	Fringes
COMMUNICATIONS & SYSTEMS TECHNICIAN	15.97	3.61

SCOPE OF WORK

Includes the installation, testing, service and maintenance, of the following systems which utilize the transmission and/or transference of voice, sound vision and digital for commercial, education, security and entertainment purposes for the following: TV monitoring and surveillance, background-foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, nurse call system, radio page, school intercom and sound, burglar alarms, and low voltage master clock systems.

**WORK EXCLUDED**

Raceways systems are not covered (excluding Ladder-Rack for the purpose of the above listed systems). Chases and/or or nipples (not to exceed 10 feet) may be installed on open wiring systems.

Energy management systems.

SCADA (Supervisory Control and Data Acquisition) when not intrinsic to the above listed systems (in the scope).

Fire alarm systems when installed in raceways (including wire and cable pulling) shall be performed at the electrician wage rate, when either of the following two (2) conditions apply:

1. The project involves new or major remodel building trades construction.
2. The conductors for the fire alarm system are installed in conduit.

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ELEC0112M 06/01/1998		
	<b>Rates</b>	<b>Fringes</b>
ELECTRICIANS	26.20	6.83+3%
CABLE SPLICERS	27.51	6.83+3%

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PLAS0072D 06/01/1998		
	<b>Rates</b>	<b>Fringes</b>
ZONE 1:		
CEMENT MASONS	20.24	5.14

Zone Differential (Add to Zone 1 rate): Zone 2: \$2.00

BASE POINTS: Spokane, Pasco, Moses Lake, Lewiston

Zone 1: 0 - 45 radius miles from the main post office  
Zone 2: Over 45 radius miles from the main post office

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* PLUM0598C 06/01/1998		
	<b>Rates</b>	<b>Fringes</b>
PLUMBERS AND STEAMFITTERS	27.80	9.60

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ROOF0189D 07/01/1997		
	Rates	Fringes
ROOFERS (Excluding waterproofing)	17.60	5.60
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SHEE0066C 06/01/1998		
	Rates	Fringes
SHEET METAL WORKERS (Excluding structural iron work on metal building)	23.93	6.87
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SUWA1001A 02/08/1990		
	Rates	Fringes
BRICKLAYERS	17.99	3.73
CARPENTERS	12.24	3.20
LABORERS	9.15	
PAINTERS	14.03	2.70
-----		
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

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------------	----------------------

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## SECTION 01001

## SUPPLEMENTARY REQUIREMENTS

## PART 1 GENERAL

## 1.1 DEFINITIONS

The references listed below are to be defined as indicated wherever they may be used in the TECHNICAL SPECIFICATIONS.

"SUPPLEMENTARY REQUIREMENTS " shall be read to pertain to any of the sections of the DIVISION 1 as required by the content of the section or paragraph containing the reference.

## 1.2 CONSTRUCTION SCHEDULING

## 1.2.1 Construction Progress Charts And Status Reports:

1.2.1.1 The instructions and information herein supplement the requirements of Paragraph SCHEDULE FOR CONSTRUCTION CONTRACTS IN THE CONTRACT CLAUSES. The proposed Construction Progress Chart shall be prepared on ENG Form 2454. Additional instructions are obtained in INSTRUCTIONS AND INFORMATION FOR CONTRACTORS, a manual furnished to the Contractor by the Contracting Officer. This manual is available for inspection in the Office of the Seattle District, Corps of Engineers 4735 East Marginal Way South, Seattle, Washington.

1.2.1.2 The Minimum principal contract features (activities) to be included on ENG Form 2454 shall represent the work in each of the following divisions:

- (a) Site Work
- (b) Concrete
- (c) Masonry
- (d) Metals
- (e) Thermal and Moisture Protection
- (f) Doors and Windows
- (g) Finishes
- (h) Specialties
- (i) Equipment
- (j) Special Construction
- (k) Mechanical
- (l) Electrical

1.2.2 The Construction Progress Chart shall show the total bid amount distributed among the features shown on the chart. The schedule shall show the percentage of completion at the close of each weekly period. This percentage shall be based on percentage of physical completion of the work. (NOTE: Mobilization and demobilization shall not be listed as a separate payment item unless so noted in the schedule.)

1.2.3 The Construction Progress Chart shall be submitted within 10 calendar days after the date of receipt of notice to proceed.

1.2.4 The Contractor shall prepare and submit a monthly project status report. The report shall tell whether the project as a whole is on, ahead of, or behind schedule. If the project is behind schedule, the Contractor shall explain what actions he will take to regain his schedule. The report shall include a description of problem areas, delaying factors and their impact, and an explanation of corrective actions taken or proposed. Any delays caused by the Government shall be identified. Any significant items or events that occurred during the report month shall also be detailed.

### 1.3 CORRESPONDENCE

1.3.1 All correspondence shall be addressed to the Administrative Contracting Officer, shall be serially numbered commencing with Number 1, with no numbers missing or duplicated and shall be furnished with an original and one copy. Enclosures attached or transmitted with the correspondence shall also be furnished with an original and one copy. Each serial letter shall make reference to the contract name, contract number and shall have only one subject.

1.3.2 All correspondence from the Contracting Officer will be also serially numbered with no numbers missing or duplicated. Letters to the Contractor will be forwarded in duplicate.

1.3.3 In the event there is more than one project within a contract, correspondence shall contain separate and distinct submittals to identify each project by name.

1.3.4 For submission of Contractor payment requests, See Section 01025, PAYMENT.

### 1.4 ADVANCED NOTICE OF CONTRACTOR PERFORMED ACCEPTANCE TESTING

The Contractor shall notify the Contracting Officer a minimum of 14 days prior to performing any acceptance or "buy off" testing of the following system(s), Engine Generator Set. Advance notification is not required for testing performed as part of fabrication or installation.

### 1.5 CONTRACTOR'S FILES

Contractor shall maintain "Approved (Action Code "A") and "Approved Except as Noted (Action Code "B") shop drawing files in fabrication shops and at project sites for government use.

### 1.6 IDENTIFICATION OF EMPLOYEES AND MILITARY REGULATIONS

(a) The Contractor shall be responsible for compliance with all regulations and orders of the Commanding Officer of the Military Installation, with respect to identification of employees, movements on installation, parking, truck entry, and all other military regulations which may effect the work.

(b) The work under this Contract is to be performed at an operating Military Installation with consequent restrictions on entry and movement of nonmilitary personnel and equipment.

(c) Contractors performing work on Yakima Training Center shall, after award, register all vehicles to be used on the installation with the MP Station. Contractor employees entering the installation in privately owned vehicles (POVs) shall also register their vehicles. A copy of contract award,

proof of liability insurance, current driver's license, and state vehicle registration shall be required to register Contractor, subcontractor, and employee vehicles.

(d) Upon completion of the contract, it shall be the prime contractor's responsibility to collect all vehicle decals issued under the contract including those issued to employees and subcontractors. Decals are to be carefully removed from the vehicle, placed in an envelope, and attached to the original documentation (i.e. post vehicle registration document) received with the decal. Decal, with documentation, must be returned to the MP Station.

(e) In the event of contract extension, it shall be the prime contractor's responsibility to report the time extension to the MP Station.

#### 1.7 SPECIAL SAFETY REQUIREMENTS:

In addition to Safety and Health Requirements Manual EM 385-1-1, dated September 1996, the Contractor shall comply with the requirements listed below. Paragraph numbers refer to EM 385-1-1 or are added thereto.

(a) Paragraph 01.A.12: Add new paragraph: Safety Personnel. The Contractor shall designate a person on his staff to manage the Contractor's safety and accident prevention program. This person will provide a point of contact for the Contracting Officer on matters of job safety, and shall be responsible for ensuring the health and safety of on site personnel.

(b) Paragraph 01.D.02, revise as follows:

- (1) Replace paragraph 01.D.02c with the following:  
"c. Property damage in excess of \$2,000.00
- (2) Add new paragraph d as follows:  
"An injury resulting in a lost workday, not including the day of injury."

#### 1.8 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (ER 415-1-15 31 OCT 89)

This Paragraph 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:

1.8.1 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.

1.8.2 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.

1.8.3 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

17 11 10 5 2 1 1 1 1 4 10 14 Yakima, WA

1.8.4 Upon acknowledgment of the notice to proceed (NTP) and continuing throughout the contract, the contractor will record on the daily QCQ report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delays must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

1.8.5 The number of actual adverse weather delay 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 of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph 1.8.3, 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 clause entitled " Default (Fixed Price Construction)".

PARTS 2 AND 3 NOT USED

END OF SECTION

## SECTION 01005

SITE SPECIFIC  
SUPPLEMENTARY REQUIREMENTS

## 1. CONDUCT OF WORK

## 1.1 COORDINATION AND ACCESS TO SITE

1.1.1 Coordination with using agency shall be made through the Yakima Training Center Public Works (PW) to assist the Contractor in completing the work with a minimum of interference and inconvenience to occupants in the vicinity and other craftsmen who may be working on the site.

1.1.2 All vehicles and drivers entering the base shall have valid current licenses. Those entering in privately-owned vehicles or unmarked Contractor vehicles shall obtain a visitor's pass each time they enter unless that vehicle will be repeatedly used; then the Contractor is responsible for obtaining vehicle permits from the Provost Marshall.

1.1.3 Keys required by the Contractor for access to the building/area for this project shall be obtained through the PW, YTC. The Contractor has no right of access to places or at times where it is not specifically granted such access by other provisions of this contract, or by PW, YTC.

1.1.3.1 The Contractor shall be responsible for Government-owned keys issued for access to facilities or areas pertinent to this contract.

1.1.3.2 Upon completion of the work in an area, or upon request of the Contracting Officer, the key or keys relevant to the completed areas shall be returned.

1.1.3.3 Should the Contractor lose a key:

a. the Contracting Officer shall be notified, in writing, within three (3) working days after the loss is discovered and

b. should the key not be found before final acceptance, the final contract payment shall be reduced by \$100 for each key not returned.

1.1.4 Work hours in the construction area will be restricted to 7:30 a.m. to 4 p.m. daily, Monday through Friday, excluding Federal holidays. Work hours other than as specified above shall be coordinated with and approved by the Contracting Officer.

1.1.5 In order to prevent an accidental communication outage, no ground breaking or earth moving work shall be performed until installation of the Fiber Optic (FO) cable between Dial Central Office (DCO) and Range Control is operational and has been accepted by the Government.

## 1.2 UTILITY OUTAGES

Contractor shall coordinate utility outages with the Yakima Directorate of Installation Support, through the Contracting Officer, at least 7 days in advance. Director of Installation Support is Jesse Hayden, phone (509) 577-3810. Outages shall be kept to a minimum and any one outage shall not last more than 2 hours, except telephone outages. Telephone outages are required in this contract and shall be done during non-business (non-working) hours. Telephone outages shall not last longer than 1 hour.

## 1.3 CONSTRUCTION PHASING

Tracked vehicle turning pads shall be constructed during the period 15 July to 15 October.

## 2. IDENTIFICATION

2.1 Contractor's workmen shall have on either a uniform with the firm name and the workman's last name or shall have a badge pinned on with both the firm name and the workman's photograph and full name.

2.2 All Contractor-owned and privately-owned vehicles require an access pass/vehicle decal. See Paragraph IDENTIFICATION OF EMPLOYEES AND MILITARY REGULATIONS in SECTION 01001 for specific requirements.

END OF SECTION

REISSUED SECTION BY AMENDMENT R0005

## SECTION 01025

## PAYMENT

## PART 1 GENERAL

## 1.1 GENERAL

The contract price for each item shall constitute full compensation for furnishing all plant, labor, materials, appurtenances, and incidentals and performing all operations necessary to construct and complete the items in accordance with these specifications and the applicable drawings, including surveying performed by the Contractor. Payment for each item shall be considered as full compensation, notwithstanding that minor features may not be mentioned herein. Work paid for under one item will not be paid for under any other item. No separate payment will be made for the work, services, or operations required by the Contractor, as specified in DIVISION 1, GENERAL REQUIREMENTS, to complete the project in accordance with these specifications; all costs thereof shall be considered as incidental to the work.

## 1.2 PAYMENT

## 1.2.1 ITEM NO. 0001 (Base Item)

Payment will be made at the contract lump sum price for Item No. 0001, All Work for Project Entitled Centralized Fuel Station, Except For Item 0002, payment of which shall constitute full compensation for Item No. 0001, complete.

## 1.2.2 ITEM NO. 0002 (Additive Item)

Payment will be made at the contract lump sum price for Item No. 0002, Gravel Wearing Course, PCC Turning Pad, and Culverts as Shown on Plates C-2, C-6 and C-4, payment of which shall constitute full compensation for Item No. 0002, complete.

## 1.3 PROGRESS PAYMENT INVOICE

Requests for payment shall be submitted in accordance with Federal Acquisition Regulations (FAR) Subpart 32.9, entitled "PROMPT PAYMENT", and Paragraphs 52.232-5 and 52.232-27, entitled "Payments Under Fixed-Price Construction Contracts", and "Prompt Payment for Construction Contracts", respectively. In addition each request shall be submitted in the number of copies and to the designated billing office as shown in the Contract.

1.3.1 When submitting payment requests, the Contractor shall complete Blocks 1 through 12 of the "PROGRESS PAYMENT INVOICE" Form as directed by the Contracting Officer. (A sample form is attached at the end of this Technical Specification Section.) The completed form shall then become the cover document to which all other support data shall be attached.

1.3.2 One additional copy of the entire request for payment, to include the "PROGRESS PAYMENT INVOICE" cover document, shall be forwarded to a separate address as designated by the Contracting Officer.

1.3.3 The Contractor shall submit with each pay request, a list of subcontractors that have worked during that pay period. The listing shall be broken down into weeks, identifying each subcontractor that has worked during a particular week, and indicate the total number of employees that have worked on site for each subcontractor for each week. The prime Contractor shall also indicate the total number of employees for its on site staff for each week.

PARTS 2 and 3 NOT USED

**PROGRESS PAYMENT INVOICE**

See Federal Acquisition Regulations (FAR) 32.900, 52.232-5, & 52.232-27

1. PROJECT AND LOCATION	2. DATE
3. CONTRACTOR NAME AND ADDRESS (Must be the same as in the Contract)	4. CONTRACT NO.  5. INVOICE NO.
6. DESCRIPTION OF WORK	7. PERIOD OF PERFORMANCE  From:  To:
8. DISCOUNT TERMS	
9. OFFICIAL TO WHOM PAYMENT IS TO BE FORWARDED Name: Title: Phone: ( ) -	10. OFFICIAL TO BE NOTIFIED OF DEFECTIVE INVOICE Name: Title: Phone ( ) -
<p><b>11. CERTIFICATION: I hereby certify, to the best of my knowledge and belief, that</b></p> <p><b>(1) The amounts requested are only for the performance in accordance with the specifications, terms, and conditions of this contract;</b></p> <p><b>(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</b></p> <p><b>(3) This request for progress payment 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.</b></p> <p>_____ (Signature) _____ (Title) _____ (Date)</p>	
<p>12. OTHER INFORMATION OR DOCUMENTATION required by Contract. Provide two (2) copies of each (check and attach if applicable):</p> <p>_____ Updated Progress Chart/Schedule</p> <p>_____ Progress Narrative</p> <p>_____ Certified Payrolls (submitted weekly)</p> <p>_____ Safety Exposure Report</p> <p>_____ Updated Submittal \register</p> <p>_____ Progress Photos</p> <p>_____ Subcontractor/Employee Listings</p>	<p>(FOR GOVERNMENT USE ONLY)</p> <p>Retainage: _____% Amt: \$_____</p> <p>Withholdings: \$_____</p> <p>Reason: _____ _____</p> <p>Following items are current:</p> <p>As-Builts _____ Yes _____ No</p> <p>O &amp; M Manuals _____ Yes _____ No</p> <p>1354 Data _____ Yes _____ No</p> <p>Submittal Register _____ Yes _____ No</p>

END OF SECTION

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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.

### 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 01035

## MODIFICATION PROCEDURES

## PART 1 GENERAL

## 1.1 PROPOSED PROJECT MODIFICATIONS:

Price proposals for proposed modifications shall be submitted in accordance with the requirements of the Contract Clause MODIFICATION PROPOSALS - PRICE BREAKDOWNS. If change order work impacts or delays other unchanged contract work, the costs of such impacts or delays shall be included in the proposals and separately identified. Additional instructions for submitting price proposals can be found in NPSP-415-1-1, INSTRUCTION AND INFORMATION FOR CONTRACTORS, a copy of which will be furnished to the Contractor at the Preconstruction Conference. For information applicable to equipment rates used in contract modifications, refer to Section 00800 - SPECIAL CLAUSES, clause "EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE."

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

END OF SECTION



## SECTION 01061

## ENVIRONMENTAL PROTECTION

## PART 1 GENERAL

## 1.1 SCOPE

This Section covers prevention of environmental pollution and damage as the result of construction operations under this contract. For the purpose of this specification, environmental pollution, and damage 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; affect other species of importance to man; or degrade the utility of the environment for esthetic, cultural, and/or historical purposes. The control of environment pollution and damage requires consideration of air, water, and land, and includes management of visual esthetics, noise, and solid waste, as well as other pollutants.

## 1.2 QUALITY CONTROL

The Contractor shall establish and maintain quality control for environmental protection of all items set forth herein. The Contractor shall record any problems in complying with laws, regulations, and ordinances, and corrective action taken.

## 1.2.1 Subcontractors

Assurance of compliance with this Section by subcontractors will be the responsibility of the Contractor.

## 1.3 NOTIFICATION

When the Contracting Officer notifies the Contractor in writing of any observed noncompliance with Federal, state, or local laws, regulations, or permits, the Contractor shall, after receipt of such notice, inform the Contracting Officer of proposed corrective action and take such action as may be approved. If the Contractor fails 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 time extensions will be granted or costs or damage allowed to the Contractor for any such suspension.

## 1.4 PROTECTION OF ENVIRONMENTAL RESOURCES

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be protected during the entire period of this contract. The Contractor shall confine his activities to areas defined by the drawings and specifications. Environmental protection shall be as stated in the following subparagraphs:

## 1.4.1 Protection of Land Resources

The Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without special permission from the Contracting Officer except as otherwise specified or indicated.

#### 1.4.2 Protection of Drainages, Streambeds, and Water Courses

Care shall be taken to avoid any sediment from entering stream channels during construction of fords, roads, and culverts. All excavation spoils will be hauled a sufficient distance so that they cannot reenter the stream. All stockpiles will have silt fences properly installed (follow manufacturers instructions) on the downhill side from construction sites when the stockpiles contain loose fines. No loose fines will remain on the road surface or bank face at the time of project completion. Disturbance of the stream channel will be limited to that necessary to install the ford or culvert. Affected bed areas outside the ford will be restored to previous condition. Within 48 hours after completion of each element (ford, road, culvert) the Contracting Officer will be notified.

#### 1.4.3 Disposal of Solid Wastes

Solid wastes shall be placed in containers which are emptied on a regular schedule. All handling and disposal shall be conducted to prevent contamination.

#### 1.4.4 Refuse Disposal and Cleanup

Refuse shall be defined as debris other than such organic materials as brush or tree stumps.

##### 1.4.4.1 Refuse Disposal

The cost of refuse disposal, such as transportation, handling, dumping fees as applicable, and similar cost, shall be included in the contract price. Refuse shall be disposed of off site, in accordance with all local, state, and Federal rules and regulations, at the Contractor's expense.

##### 1.4.4.2 Fire Hazard

Cloths, cotton waste, and other combustible materials that might constitute a fire hazard shall be placed in closed metal containers and placed outside or destroyed at the end of each day.

#### 1.4.5 Restrictions

The Contractor will not be permitted to deposit refuse in existing garbage cans or refuse dumpsters. Cleaners shall not be poured, drained, or washed into plumbing fixtures or sanitary or storm sewers. Debris, dirt, dust, and stains attributable to or resulting from the work effort shall be removed, cleaned, or effaced by the Contractor to the satisfaction of the Contracting Officer prior to acceptance of the job. Refuse shall not be burned. Burning of vegetation or tree stumps will not be allowed unless the worksite is in an area approved for burning.

#### 1.4.6 Disposal of Chemical or Hazardous Waste

Chemical or hazardous waste shall be stored in corrosion-resistant containers, removed from the work area, and disposed of in accordance with Federal, state, and local regulations. Accidental spills of POL will be reported to the Contracting Officer and all cleanup and disposal costs are the responsibility of the Contractor.

#### 1.4.7 Disposal of Discarded Materials

Discarded materials, other than those which can be included in the solid waste category, shall be disposed at the Contractor's responsibility and cost.

#### 1.4.8 Protection of Water Resources

The Contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. All equipment will be in acceptable condition and free of defects which allow discharge of petroleum, oils, and lubricants onto the ground. Contractor shall have spill kit on site capable of cleaning any spill of hydraulic tank contents.

#### 1.4.9 Particulates

Dust particles, aerosols, and gaseous byproducts from construction activities, processing, and preparation of materials shall be controlled at all times, including weekends, holidays, and hours when work is not in progress. Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and state allowable limits at all times.

### 1.5 CULTURAL RESOURCE PROTECTION

#### 1.5.1 Prehistoric Occupation Debris

If, during construction activities the Contractor observes evidence of prehistoric occupation such as bone fragments, charcoal, fire-modified rock and cryptocrystalline flaking debris, in a place not previously identified, the Contractor shall cease work in the area of the find, leaving all objects in place. An on-site inspection of the site by Government cultural resource specialists will occur within 48 hours of receiving notice to determine their significance and what, if any, special disposition of the find should be made.

#### 1.5.2 Human Skeletal Remains

If, during construction activities, the Contractor observes human skeletal remains, the Contractor shall notify the Contracting Officer within 4 hours of the find. The Contractor shall cease all activities in the area of the discovery and redirect work to other areas. Construction activity in the area may resume after 30 days from notification to the Contracting Officer. Disposition shall take place within 30 days of the find, in conformity with Native Graves Protection and Repatriation Act.

### 1.6 MAINTENANCE OF POLLUTION CONTROL FACILITIES

The Contractor shall maintain all constructed facilities and portable pollution control devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

### 1.7 RESTORATION OF LANDSCAPE DAMAGE AT FORD SITES

Grass areas damaged at ford sites shall be replaced in kind by seeding. Grass seeding shall be installed on a minimum 2-inch topsoil and as recommended by the local county extension service. All seeding shall take place in the period between 1 October and 15 November.

END OF SECTION

01061-3



## SECTION 01300

## SUBMITTALS

## PART 1 GENERAL

## 1.1 CONTROL AND SCHEDULING OF SUBMITTALS

## 1.1.1 Submittal Coordination Meeting

After the preconstruction conference and before any submittals are sent to the Contracting Officer's Representative (COR), with the exception of Division 1 submittals, the Contractor shall meet with the COR to develop an approved preliminary submittal register, ENG Form 4288. During the meeting all required items will be identified and grouped into three categories:

- Government Approved (GA)
- Government approval is required for extensions of design, critical materials, variations/deviations, an "or equal" decision, equipment whose compatibility with the entire system must be checked, architectural items such as Color Charts/Patterns/Textures, and other items as designated by the COR. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," these submittals will be acted on as "shop drawings."
- For Information Only (FIO)
- Submittals not requiring Government approval will be for information only. These are items such as Installation Procedures, Certificates of compliance, Samples, Qualifications, etc. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," these submittals will not be acted on as "shop drawings."
- Those items that can be visually inspected by the Contractor's Quality Control Representative (CQC) on site or are provided to the Government other than with an ENG Form 4025: The items that fall into this category shall remain on the register but shall not be submitted to the COR. For these items, the "Classification" column on the submittal register shall remain blank.

## 1.1.2 Final Submittal Register

The final submittal register shall be coordinated with the progress schedule and submitted within 40 days of Notice to Proceed. In preparing the final document, adequate time (minimum of 30 days) shall be allowed for review and approval, and possible resubmittal of each item on the register.

## 1.1.3 Submittal Register Updates

The Contractor's quality control representative shall review the listing at least every 30 days and take appropriate action to maintain an effective system. Copies of updated or corrected listings shall be submitted to the COR at least every 30 days in the quantity specified.

## 1.2 SUBMITTAL TYPES

Throughout these specifications submittals may be identified with the prefix "SD" (submittal data) followed by a number (category, i.e., data, drawings, reports, etc.). This is for bookkeeping and record sorting in the system:

## Data

Submittals which provide calculations, descriptions, or documentation regarding the work.

## Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

#### Instructions

Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

#### Schedules

Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

#### Statements

A document, required of the Contractor, or through the Contractor from a subcontractor, supplier, installer, or manufacturer to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other quality verifications.

#### Reports

Reports of inspections or tests, including analyses and interpretation of test results. Each report shall be properly identified. Test methods used shall be identified and test results shall be recorded.

#### Certificates

Statement signed by an official authorized to certify on behalf of the manufacturer that a product, system or material meets specified requirements. The statement must be dated after the award of this contract and state the Contractor's name and address, project and location, and list specific requirements which are being certified.

#### Samples

Fabricated and/or unfabricated physical examples of materials, products, and/or units of work as complete units or as portions of units.

#### Records

Documentation to record compliance with technical or administrative requirements.

#### Operation and Maintenance Manuals

Data which forms a part of an operation and maintenance manual.

Submittals required by the Contract Clauses and other non-technical parts of the contract are not necessarily included in this section. These type of submittals can be added to the register before or during the submittal coordination meeting.

### 1.3 APPROVED SUBMITTALS

The approval of submittals by the COR 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. The Contractor, under the CQC requirements of this contract, is responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work. After submittals have been approved by the COR, no resubmittal for the purpose of substituting materials or equipment will be given consideration.

### 1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the COR and promptly furnish a corrected submittal in the format 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, written notice, as required under the Contract Clause entitled "Changes," shall be given to the COR.

### 1.5 PAYMENT

Separate payment will not be made for submittals, and all costs associated therein shall be included in the applicable unit prices or lump sum prices contained in the schedule. Payment will not be made for any material or equipment which does not comply with contract requirements.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

### 3.1 GENERAL

Prior to submittal, all items shall be checked and approved by the Contractor's CQC and each item of the submittal shall be stamped, signed, and dated. Each respective transmittal form (ENG Form 4025) shall be signed and dated by the CQC certifying that the accompanying submittal complies with the contract requirements. This procedure applies to all submittals. 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 lists; certifications; warranties and other such required items. Units of weights and measures used on all submittals shall be the same as the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. GA submittals shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. The COR may request submittals in addition to those listed when deemed necessary to adequately describe the work covered in the respective sections. The Contractor shall maintain a complete and up-to-date file of all submittals/items on site for use by both the Contractor and the Government.

### 3.2 SUBMITTAL REGISTER (ENG Form 4288)

The Contractor shall approve all items listed on the submittal register. The ENG Form 4288 in APPENDIX A immediately following this specification Section lists each item of equipment and material for which submittals are required. During the submittal coordination meeting, a preliminary submittal register will be created by annotating this Form 4288. When the final submittal register is submitted for approval, the Contractor shall complete the column entitled "Item No." and all data under "Contractor Schedule Dates" and return five completed copies to the COR for approval. The Contractor shall review the list to ensure its completeness and may expand general category listings to show individual entries for each item. The numbers in column "Item No." are to be assigned sequentially starting with "1" for each specification section. DO NOT preassign transmittal numbers when preparing the submittal register. When a conflict exists between the submittal register and a submittal requirement in the technical sections, other than those submittals referenced in Paragraph 3.9: Field Test Reports, the approved submittal register shall govern. The preliminary, and then the final approved submittal register, will become the scheduling documents and will be updated monthly and used to control submittals throughout the life of the contract. Names and titles of individuals authorized by the Contractor to approve shop drawings shall be submitted to COR with the final 4288 form. Supplier or subcontractors certifications are not acceptable as meeting this requirement.

### 3.3 SCHEDULING

Submittals covering component items forming a system, or items that are interrelated, shall be coordinated and submitted concurrently. Certifications shall be submitted together with other pertinent information and/or drawings. Additional processing time beyond 30 days, or number of copies, may be shown by the COR on the submittal register attached in the "Remarks" column, or may be added by the COR during the coordination meeting. No delays damages or time extensions will be allowed for time lost due to the Contractor not properly scheduling and providing submittals.

### 3.4 TRANSMITTAL FORM (ENG Form 4025)

Transmittal Form 4025 (sample at end of this section) shall be used for submitting both GA and FIO submittals in accordance with the instructions on the reverse side of the form. Transmittal numbers shall be assigned sequentially. Original 4025 forms shall be used (do not photo copy) and will be furnished by the COR. These forms shall be filled in completely prior to submittal. 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.. Each submittal item shall be listed separately on the form, naming subcontractor, supplier, or manufacturer, applicable specification paragraph number(s), drawing/sheet number, pay item number, and any other information needed to identify the item, define its use, and locate it in the work. One or more 4025 forms may be used per specification section, however, DO NOT include more than one specification section per transmittal.

### 3.5 CROSS-REFERENCE (ENG FORM 4288/ENG FORM 4025)

To provide a cross-reference between the approved submittal register and transmittal forms, the Contractor shall record the "transmittal numbers" assigned when submitting items in column "Transmittal No." of the ENG FORM 4288. The item numbers in column "Item No." of submittal register shall correspond to the item numbers on ENG Form 4025.

### 3.6 SUBMITTAL PROCEDURE

#### 3.6.1 General

Shop drawings with 4025 forms shall be submitted in the number of copies specified in subparagraphs "Government Approved Submittals" and "Information Only Submittals," or as indicated on the submittal register in the "Remarks" column. Submit a complete collated "reviewers copy" with one 4025 form and attachments (not originals). The remaining copies (4 for GA, 2 for FIO) of 4025 forms and attachments shall not be collated. This would not apply to a series of drawings.

#### 3.6.2 Approval of Submittals by the Contractor

Before submittal to the COR, the Contractor shall review and correct shop drawings prepared by subcontractors, suppliers, and itself, for completeness and compliance with plans and specifications. The Contractor shall not use red markings for correcting material to be submitted. Red markings are reserved for COR's use. Approval by the Contractor shall be indicated on each shop drawing by an approval stamp containing information as shown in this section. Submittals not conforming to the requirements of this section will be returned to the Contractor for correction and resubmittal.

#### 3.6.3 Variations

For submittals which include proposed variations requested by the Contractor, column "h" of ENG Form 4025 shall be checked and the submittal shall be classified as GA, and submitted accordingly. The Contractor shall set forth in writing the justification for any variations and annotate such variations on the transmittal form in the REMARKS block. Variations are not approved unless there is an advantage to the Government. The Government reserves the

right to rescind inadvertent approval of submittals containing unnoted variations.

#### 3.6.4 Drawings

Each drawing shall be not larger than A1 size (841 mm wide by 594 mm high), with a title block in lower right hand corner and a 75 mm by 100 mm clear area adjacent. The title block shall contain the subcontractor's or fabricator's name, contract number, description of item(s), bid item number, and a revision block. Provide a blank margin of 20 mm at bottom, 50 mm at left, and 10 mm at top and right. Where drawings are submitted for assemblies of more than one piece of equipment or systems of components dependent on each other for compatible characteristics, complete information shall be submitted on all such related components at the same time. The Contractor shall ensure that information is complete and that sequence of drawing submittal is such that all information is available for reviewing each drawing. Drawings for all items and equipment, of special manufacture or fabrication, shall consist of complete assembly and detail drawings. All revisions after initial submittal shall be shown by number, date, and subject in revision block.

##### 3.6.4.1 Submittals Containing Drawings Larger than A3 size, (297 mm high by 420 mm wide)

For GA submittals containing drawings larger than A3 size, one reproducible and one blue line copy will be required to be submitted with five copies of the ENG Form 4025. The marked-up reproducible (and/or any review comments contained on the page-size comment sheet(s) at the Government's option) will be returned to the Contractor upon review. Three copies of blue line drawings (generated from the reviewed reproducible) will be provided to the Government within 10 days of Contractor's receipt of the reviewed reproducible. The Contractor shall not incorporate approved work into the project until the Government has received the three blue line copies. The Contractor shall use the marked-up reproducible to make any additional copies as needed. For FIO submittals, one reproducible and two blue line copies will be required to be submitted with the appropriate number of copies of ENG Form 4025.

#### 3.6.5 Printed Material

All requirements for shop drawings shall apply to catalog cuts, illustrations, printed specifications, or other data submitted, except that the 75 mm by 100 mm (3 inch by 4 inch) clear area adjacent to the title block is not mandatory. Inapplicable portions shall be marked out and applicable items such as model numbers, sizes, and accessories shall be indicated by arrow or highlighted.

#### 3.7 SAMPLES REQUIRING LABORATORY ANALYSIS

See Section 014CONTRACTOR QUALITY CONTROL for procedures and address for samples requiring Government testing.

#### 3.8 SAMPLES REQUIRING VISUAL INSPECTION

Samples requiring only physical inspection for appearance and suitability shall be coordinated with the on-site Government quality assurance representative (QAR).

#### 3.9 FIELD TEST REPORTS

Routine tests such as soil density, concrete deliveries, repetitive pressure testing shall be delivered to the QAR with the daily Quality Control reports. See SECTION: 01451 CONTRACTOR QUALITY CONTROL.

#### 3.10 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."

#### 3.11 GOVERNMENT APPROVED SUBMITTALS (GA)

01300-5

The Contractor shall submit 5 copies of GA submittals with 5 corresponding 4025 forms. Upon completion of GA submittal review, copies as specified below will be marked with an action code, dated, and returned to the Contractor. See "Drawings" above for special instructions if drawings larger than size A3 (11 inch by 17 inch) are used.

### 3.11.1 Processing of GA Submittals

Submittals will be reviewed and processed as follows:

a. Approved as Submitted (Action Code "A"): Shop drawings which can be approved without correction will be stamped "Approved" and two copies will be returned to the Contractor. No resubmittal required.

b. Approved Except as Noted (Action Code "B"): Shop drawings which have only minor discrepancies will be annotated in red to indicate necessary corrections. Marked material will be stamped "Approved Except as Noted" and two copies returned to the Contractor for correction. No resubmittal required.

c. Approved Except as Noted (Action Code "C"): Shop drawings which are incomplete or require more than minor corrections will be annotated in red to indicate necessary corrections. Marked material will be stamped "Approved Except as Noted - Resubmission Required" and two copies returned to the Contractor for correction. Resubmittal of only those items needing correction required.

d. Disapproved (Action Code "E"): Shop drawings which are fundamentally in error, cover wrong equipment or construction, or require extensive corrections, will be returned to the Contractor stamped "Disapproved." An explanation will be furnished on the submitted material or on ENG Form 4025 indicating reason for disapproval. Complete resubmittal required.

e. Resubmittal will not be required for shop drawings stamped "A" or "B" unless subsequent changes are made by Contractor or a contract modification. For shop drawings stamped "C" or "E," Contractor shall make corrections required, note any changes by dating the revisions to correspond with the change request date, and promptly resubmit the corrected material. Resubmittals shall be associated with the "parent" by use of sequential alpha characters (for example, resubmittal of transmittal 8 will be 8A, 8B, etc). Government costs incurred after the first resubmittal may be charged to the Contractor.

### 3.12 INFORMATION ONLY SUBMITTALS (FIO)

The Contractor shall submit three copies of data and four copies of ENG Form 4025. FIO submittals will not be returned. Government approval is not required on FIO submittals. These submittals will be used for information purposes. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the Contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications and will not prevent the COR 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.

#### 3.12.1 Processing of FIO Submittals

FIO submittals shall be submitted prior to delivery of the material or equipment to the job site. ENG Form 4025 shall be marked with the words "contractor approved - information copy only" in the REMARKS block of the form. Submittals will be monitored and spot checks made. When such checks indicate noncompliance, the Contractor will be notified by the same method

used for GA submittals. Resubmittal of nonconforming FIO submittals shall be reclassified GA and shall be in five copies.

3.13 CONTRACTOR APPROVAL STAMP

The stamp used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR:
_____
CONTRACT NUMBER
_____
TRANSMITTAL NUMBER _____
ITEM NUMBER _____
SPECIFICATION SECTION _____
PARAGRAPH NUMBER _____
_____ APPROVED AS SUBMITTED
_____ APPROVED WITH CORRECTIONS AS NOTED
SIGNATURE: _____
TITLE: _____
_____ DATE
_____

CONTRACTORS REVIEW STAMP  
MAXIMUM SIZE:  
3 INCHES BY 3 INCHES



**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; on 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.
  4. Submittals requiring expeditious handling will be submitted on a separate form.
  5. Separate transmittal form will be used for submittals under separate sections 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.
- |   |    |  |    |    |  |
|---|----|--|----|----|--|
| A | -- | Approved as submitted.   | E  | -- | Disapproved (See attached).  |
| B | -- | Approved, except as noted on drawings.   | F  | -- | Receipt acknowledged.  |
| C | -- | Approved, except as noted on drawings.<br>Refer to attached sheet resubmission required. | FX | -- | Receipt acknowledged, does not comply as noted with contract requirements. |
| D | -- | Will be returned by separate correspondence.   | 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)*

APPENDIX A

SUBMITTAL REGISTER  
(ENG FORM 4288)

## SECTION 01400

## CONTRACTOR QUALITY CONTROL

## 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 (1994) Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (1993) Use in the Evaluation of Testing and Inspection Agencies as 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 Clause entitled "Inspection of Construction", in SECTION 00700 of this document.

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 on-site and off-site, and shall be keyed to the proposed construction sequence.

## 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 on-site and off-site, 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 who shall report to the project manager or someone higher in the Contractor's organization. Project manager in this context shall mean the individual with responsibility for the overall management of the project including quality and production.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC 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, off-site fabricators, suppliers and purchasing agents. These procedures shall be in accordance with Section 01300 SUBMITTALS.

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. This shall include a copy of the Daily CQC report form.

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.

### 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 QC plan, the Contractor shall notify the Contracting Officer in writing a minimum of seven calendar days prior to 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 Quality Control Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. 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 on-site and off-site 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 CQC System Manager

The Contractor shall identify 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. This CQC System Manager shall be on the site at all times during construction and will be employed by the Contractor, except as noted in the following. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the system manager's absence. Period of absence may not exceed 2 weeks at any one time. The requirements for the alternate will be the same as for the designated CQC manager.

#### 3.4.2 CQC Organizational Staffing

The Contractor shall provide a CQC staff which shall be at the site of work at all times during progress, with complete authority to take any action necessary to ensure compliance with the contract.

##### 3.4.2.1 CQC Staff

Following are the minimum requirements for the CQC staff. These minimum requirements will not necessarily assure an adequate staff to meet the CQC requirements at all times during construction. The actual strength of the CQC staff may vary during any specific work period to cover the needs of the work period. When necessary for a proper CQC organization, the Contractor will add additional staff at no cost to the Government. This listing of minimum staff in no way relieves the Contractor of meeting the basic requirements of quality construction in accordance with contract requirements. All CQC staff members shall be subject to acceptance by the Contracting Officer.

##### 3.4.2.2 CQC System Manager

The CQC system manager shall be a graduate engineer, or a graduate of construction management, with a minimum of 3 years construction experience on similar type construction to this contract. The CQC system manager shall assigned as system manager but may have duties as project superintendent and safety officer in addition to quality control.

In addition to the above experience and education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management for Contractors" prior to start of field work. This one day course is periodically offered in Spokane, Boise, Portland, and Seattle. For further information contact the Construction Division Office in your area.

#### 3.4.2.3 Supplemental Personnel

A staff shall be maintained under the direction of the CQC system manager to perform all QC activities. The staff must be of sufficient size to ensure adequate QC coverage of all work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities. The QC plan will clearly state the duties and responsibilities of each staff member.

#### 3.4.3 Organizational Changes

The Contractor shall obtain Contracting Officer's acceptance before replacing any member of the CQC staff. Requests shall include the names, qualifications, duties, and responsibilities of each proposed replacement.

### 3.5 SUBMITTALS

Submittals shall be as specified in Section 01300 SUBMITTALS. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements. The Government will furnish copies of test report forms (See Table 2) upon request by the Contractor. The Contractor may use other forms as approved.

### 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. The controls shall be adequate to cover all construction operations, including both on-site and off-site fabrication, and will be keyed to the proposed construction sequence. The controls shall include at least three phases of control to be conducted by the CQC system manager for all definable features of work, as follows:

#### 3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work and shall include:

- a. A review of each paragraph of applicable specifications.
- b. A review of the contract plans.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. A check to assure that provisions 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 drawing 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 constructing the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that phase 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. The Government shall be notified at least 48 hours in advance of beginning any of the required action of the preparatory 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 QC 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 preliminary work to ensure that it is in compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verification of 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 sample panels is 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 QC 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 on-site, or any time acceptable specified quality standards are not being met.

### 3.6.3 Follow-up Phase

Daily checks shall be performed to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of work for the day or shift. 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 may be conducted on the same definable features of work as determined by the Government if the quality of on-going work is unacceptable; or if there are changes in the applicable QC staff or in the on-site production supervision or work crew; or 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 tests specified or required to verify that control measures are adequate to provide a product which conforms to contract requirements, see Table 1-Minimum Testing. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory. A list of tests to be performed shall be furnished as a part of the CQC plan. The list shall give the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required. 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 Quality Control report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. Actual test reports may be submitted later, if approved by the Contracting Officer, with a reference to the test number and date taken. An information copy of tests performed by an off-site 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. Test results shall be signed by an Engineer Registered in the state where the tests are performed.

#### 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. Costs of testing the Contractor Laboratory facilities for Government acceptance shall be borne by the Contractor. Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329, and be accredited by the American Association of Laboratory

Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. All personnel performing concrete testing shall be certified by the American Concrete Institute (ACI). The contractor shall submit documentation showing the AALA, or other approved testing facility, certification, personnel ACI certifications, and the name and work experience of the Registered Professional Engineer on the staff.

### 3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$500.00 plus travel costs 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 the following address:

Director  
U.S. Army Corps of Engineers  
Material Testing Center  
Waterways Experiment Station  
3909 Hall Ferry Road  
Vicksburg, MS. 39180-6199  
Telephone: (610) 634-3974

ATTN: Project \_\_\_\_\_, Contract Number \_\_\_\_\_

Coordination for each specific test, exact delivery location and dates will be made through the Area Office.

If samples are scheduled to arrive at the laboratory on a weekend (after 1700 Friday through Sunday) notify the laboratory at least 24 hours in advance at (402) 444-4317 to arrange for delivery.

## 3.8 COMPLETION INSPECTION

At 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 plans 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 and so notify the Government. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time stated for completion of the entire work or any

particular increment thereof if the project is divided into increments by separate completion dates.

### 3.9 DOCUMENTATION

The Contractor shall maintain current records of quality control operations, activities, and tests performed, including the work of subcontractors and suppliers. These records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed today, 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/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- e. Material received with statement as to its acceptability and storage.
- f. Identify 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. List instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.
- k. 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.

### 3.10 SAMPLE FORMS

Sample Contractor Quality Control Report forms are enclosed at the end of this section.

### 3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor at the site of the work, 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.

TABLE 1  
MINIMUM SAMPLING AND TESTING FREQUENCY

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
<u>Fills, Embankments, Backfills, Subgrade, Subbase, and Base Course Material</u>		
Fill and Embankment	Field Density <sup>2/12/</sup>	One test per lift for each increment or fraction of 60 sy at each site and any time material type changes.
	Lab Density <sup>3/</sup>	One test initially per each type of materials or blended material and any time material type changes, and one every 10 field density tests.
	Gradation <sup>1/</sup>	One test every 200 cubic yards of fill for each type of materials or blended material and any time material type changes.
Subgrade	Field Density <sup>2/12/</sup>	One test per each increment or fraction of 60 s.y. at each site
	Lab Density <sup>3/</sup>	One test every 10 field density tests.
Backfill for Culverts, Trenches, Buildings and Walls, Pavements, and Other Structures	Field Density <sup>2/12/</sup>	Culverts: One test per each lift.
		Trenches: One test per lift for each increment or fraction of 100 linear feet for backfill at each site. Under pavements, one test every lift and at every crossing.

TABLE 1 (con.)

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
Backfill for Culverts, Trenches, Buildings and Walls, Pavements, and Other Structures (Con.)		Walls and Buildings Perimeters, Including Footings: One test per lift for each increment or fraction of 200 linear feet of backfill.
		Buildings Slabs on Grade: One test per lift for each increment or fraction of 400 s.f. at each site
		Areas enclosed by grade beams, compacted with power driven hand operated compactors: One test per lift for each increment or fraction of 500 s.f.
		Pavements: Two tests per lift for each increment or fraction of 2000 s.y.
		Other Structures: One test per lift for each increment or fraction of 200 linear feet of backfill.
		One test initially per each type of material or blended material and one every 10 field density tests.
	Lab Density <sup>3/</sup>	
	Gradation <sup>1/</sup>	One test per each type of material or blended material and one every 10 field density tests.
Subbase and Base	Gradation <sup>1/</sup> (including .02 mm particles size limits.	1 sample for every 2,000 sy.
	In-Place Density <sup>2/</sup> <u>12/</u>	1 sample every 1,000 sy.
	Moisture-Density Relationship <sup>3/</sup>	1 initially and every 10 density tests.

TABLE 1 (con.)

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
<u>Asphaltic Concrete and Pavements</u> (Non airfield)		
Asphaltic concrete	Marshall method Test	1 test per day minimum and 1 per 1,000 tons thereafter.
	Specific Gravity	per each Marshall Test.
	Extraction	1 test for each Marshall Method.
	Gradation <sup>5/</sup>	1 per each extraction test.
	Fracture faces <sup>5/</sup>	1 per each extraction test.
Cored or sawed specimens	Perform complete test (thickness, in-place density and bulk specific gravity) on each cored or sawed sample. <sup>12/</sup>	Take 1 set of 3 cored sawed specimens for each 1,000 square yards or fraction thereof.  One specimen shall be taken from longitudinal joint or from transverse joint.
<u>Portland Cement Concrete</u> (Non airfield)		
Coarse and Fine Aggregate <sup>7/</sup>	Moisture, specific gravity and absorption <sup>8/</sup>	1 initially.
	Gradation and fineness modules	1 every 100 cy of concrete.
	Moisture, specific gravity and absorption <sup>8/</sup>	(same as coarse aggregate).
Concrete	Slump	Conduct test every day of placement and for every 25 cy and more frequently if batching appears inconsistent. Conduct with strength tests.
	Entrained Air	Conduct with slump test.
	Ambient and concrete temperatures	Conduct with slump tests.

TABLE 1 (con.)

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
Concrete (Con.)	Unit weight, yield, and water cement ratio	Conduct with strength tests. Check unit weight and adjust aggregate weights to insure proper yield.
	Flexural strength and evaluation	When specified for slabs on grade or for concrete pavements, take one set of 6 beams every 100 cy of concrete with a minimum of 1 set per day. Two beams shall be tested at 7 days, two at 28 days, and two at 90 days.
	Compressive strength	One set of 3 cylinders per day and every 100 cy for each class of structural concrete. Test one cylinder at 7 days and two at 28 days. Additional field cure cylinders shall be made when insitu strengths are required to be known.
Vibrators	Frequency and amplitude	Check frequency and amplitude initially and any time vibration is questionable.

## NOTES:

- 1/ All acceptance tests shall be conducted from in-place samples.
- 2/ Additional tests shall be conducted when variations occur due to the contractors operations, weather conditions, site conditions, etc.
- 3/ Classification (ASTM D-2487), moisture contents, Atterberg limits and specific gravity tests shall be conducted for each compaction test if applicable.
- 4/ Materials to be submitted only upon request by the Contracting Officer.
- 5/ Tests can substitute for same tests required under "Aggregates" (from bins or source), although gradations will be required when blending aggregates.
- 6/ Increase quantities by 50 percent for Paving mixes and by 100 percent for Government testing of admixtures. Include standard deviation for similar mixes from the intended batch plant and data from a minimum of 30 tests, if available. Refer to ACI 214.
- 7/ A petrographic report for aggregate is required with the sample for source approval. If the total amount of all types of concrete is less than 200 c.y. service records from three separate structures in similar environments which used the aggregates may substitute for the petrographic report.
- 8/ Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for w/c calculations.
- 9/ thru 11/ (Not used)
- 12/ The nuclear densometer, if properly calibrated, may be used but only in addition to the required testing frequency and procedures using sandcones. The densometer shall be calibrated and is recommended for use when the time for complete results becomes critical.

TABLE 2

## STANDARD REPORT FORMS AND USE

<u>Form Number</u>	<u>Form Title</u>	<u>Form Use</u>
NPD 300	Transmittal of Material Samples	Form to accompany any samples sent to NPD Laboratory
NPD 326	Compaction Test Data Sheet	Soil compaction tests.
DD 1206	Sieve Analysis Data	Sieve analysis data sheet for soils.
NPD 320	Mechanical Analysis Test Data	Sieve analysis data sheet and hydrometer data sheet for soils.
ENG 2087	Gradation Curves	Gradation graph for soils and aggregates. (To include specification limits).
DD 1205	Soil Moisture Content	Moisture content sheet for soils and/or aggregates.
NPD 322	Specific Gravity and Absorption Test Data Sheet	Specific gravity and absorption test for soil and aggregates.
DD 1209	Atterberg Limits Determinations	Test and graph for Atterburg limits tests.
DD 1217	Bituminous Mix Design - Aggregate Blending	Aggregate blending sheet for asphaltic concrete.
NPD 346	Asphaltic Concrete Mix Design Report	Asphaltic mix design and aggregate grinding.
DD 1218	Marshall Method - Computation of Properties of Asphalt Mixtures	Marshall Test form.
NPD 88	Screen Analysis of Concrete Aggregates	Gradation test form for aggregates (self carboning).
NPD 357	Mortar Strength of Fine Aggregate Data Sheet	Flexural and compressive strength test form for mortar.
NPD 355	Data Sheet - Compressive and Flexural Strengths of Concrete	Compressive and/or flexural strength testing (include averages per specification).
NPD 359	Report of Concrete Mixture Design	Mix design sheet for Contractor mix submittal.

TABLE 2 (con.)

<u>Form Number</u>	<u>Form Title</u>	<u>Form Use</u>
NPS 57	Statistical Evaluation of Concrete Compression Tests	Summary sheet of concrete tests. Form can be used for flexural strengths if revised to conform with proper days specified. A separate sheet is to be used for each mix design.



3. QUALITY CONTROL INSPECTIONS AND RESULTS: (Include a description of preparatory, initial, and/or follow up inspections or meetings; check of subcontractors work and materials delivered to the site compared to submittals and/or specifications; comments on the proper storage of materials; include comments on corrective actions to be taken):

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4. QUALITY CONTROL TESTING AND RESULTS (comment on tests and attach test reports):

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5. DAILY SAFETY INSPECTIONS (Include comments on new hazards to be added to the Hazard Analysis and corrective action of any safety issues):

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6. REMARKS (Include conversations with or instructions from the Government representatives; delays of any kind that are impacting the job; conflicts in the contract documents; comments on change orders; environmental considerations; etc.):

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CONTRACTOR'S VERIFICATION: The above report is complete and correct. All material, equipment used, and work performed during this reporting period are in compliance with the contract documents except as noted above.

\_\_\_\_\_  
CONTRACTOR QC REPRESENTATIVE

(Sample of Typical Contractor's Test Report)

TEST REPORT

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 THE 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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

END OF SECTION



## SECTION 01501

## CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

## PART 1 GENERAL

## 1.1 AVAILABILITY OF UTILITY SERVICES

## 1.1.1 Water and Electricity

## 1.1.1.1 Water

The Government will make available to Contractor, from existing outlets and supplies, reasonable amounts of potable water without charge. Contractor shall reasonably conserve potable water furnished. Contractor, at its own expense, shall install and maintain necessary temporary connections and distribution lines and shall remove the connections and lines prior to final acceptance of construction.

## 1.1.1.2 Electricity

Electric power will be made available by the Government, without charge, to the Contractor for performing work at the work area. The Contractor shall carefully conserve electricity furnished. The Contractor, at its own expense and in a workmanlike manner satisfactory to the Contracting Officer, shall extend the existing electrical distribution system (overhead and underground) for temporary electrical service to the worksite, shall install and maintain necessary temporary connections, and shall remove the same prior to final acceptance of the construction.

## 1.2 SANITARY PROVISIONS

Contractor shall provide sanitary accommodations for the use of employees as may be necessary and shall maintain accommodations approved by the Contracting Officer and shall comply with the requirements and regulations of the State Health Department, County Sanitarian, or other authorities having jurisdiction.

## 1.3 TEMPORARY ELECTRIC WIRING

## 1.3.1 Temporary Power and Lighting

The Contractor shall provide construction power facilities in accordance with the safety requirements of the National Electric Code NFPA No. 70 and the SAFETY AND HEALTH REQUIREMENTS MANUAL EM 385-1-1. The Contractor, or its delegated subcontractor, shall enforce the safety requirements of electrical extensions for the work of subcontractors. Work shall be accomplished by journeyman electricians.

### 1.3.2 Construction Equipment

In addition to the requirements of SAFETY AND HEALTH REQUIREMENTS MANUAL, EM 385-1-1, temporary wiring conductors installed for operation of construction tools and equipment shall be either Type TW or THW contained in metal raceways, or shall be hard usage or extra hard usage multiconductor cord. Temporary wiring shall be secured above the ground or floor in a workmanlike manner and shall not present an obstacle to persons or equipment. Open wiring may only be used outside of buildings, and then only in accordance with the provisions of the National Electric Code.

### 1.3.3 Submittals

Submit detailed drawings of temporary power connections. Drawings shall include, but not be limited to, main disconnect, grounding, service drops, service entrance conductors, feeders, GFCI'S, and all site trailer connections.

### 1.4 FIRE PROTECTION

During the construction period, the Contractor shall provide fire extinguishers in accordance with the safety requirements of the SAFETY AND HEALTH REQUIREMENTS MANUAL, EM 385-1-1. The Contractor shall remove the fire extinguishers at the completion of construction.

### 1.5 STAGING AREA

Contractor will be provided adequate open staging area as directed by the Contracting Officer. Area is unsecured, and Contractor shall make provisions for its own security.

Contractor shall be responsible for keeping staging area, and office area clean and free of weeds and uncontrolled vegetation growth. Weeds shall be removed by pulling or cutting to within 1-inch of ground level. Lawn areas shall be mown to keep growth to less than 2-inches. All loose debris and material subject to being moved by prevailing winds in the area shall be picked up or secured at all times.

If the area is not maintained in a safe and clean condition as defined above the Contracting Officer may have the area cleaned by others with the costs being deducted from the Contractor's payment.

### 1.6 HOUSEKEEPING AND CLEANUP

Pursuant to the requirements of Clause CLEANING UP and Clause ACCIDENT PREVENTION, of the CONTRACT CLAUSES, the Contractor shall assign sufficient personnel to insure compliance. The Contractor shall submit a detailed written plan for implementation of this requirement. The plan will be presented as part of the preconstruction safety plan and will provide for keeping the total construction site, structures, and accessways free of debris and obstructions at all times. Work will not be allowed in those areas that, in the opinion of the Contracting Officer, have unsatisfactory cleanup and housekeeping at the end of the preceding day's normal work shift. At least once each day all areas shall be checked by the Quality Control person of the Contractor and the findings recorded on the Quality Control Daily Report. In addition, the Quality Control person shall take immediate action to insure compliance with this requirement. Housekeeping and cleanup shall be assigned by the Contractor to specific personnel. The name(s) of the personnel shall be available at the project site.

## 1.7 DIGGING PERMIT

Before performing any onsite excavation, Contractor shall obtain a digging permit. The digging permit may be obtained through coordination with Corps of Engineers office and it may take up to 14 days.

## 1.8 CONSTRUCTION NEAR COMMUNICATIONS CABLES

### 1.8.1 Excavation Near Communication Cables

Digging within .9144 meters (3 feet) of communication cables (including fiber optic cables) shall be performed by hand digging until the cable is exposed. The Contracting Officer shall be notified a minimum 3 days prior to digging within a .9144 meter (3-foot) area near cable. The cable route will be marked by the Government prior to excavation in the area. A digging permit shall be obtained by the Contractor before performing any excavation. The Contractor shall be held responsible for any damage to the cable by excavation procedures. Once the cable is exposed, mechanical excavation may be used if there is no chance of damage occurring to the cable.

### 1.8.2 Reburial of Exposed Utilities

When existing utility lines are reburied a tape, detectable by pipe detector systems, shall be installed above the uncovered length of the utility at a depth of 305 mm (12 inches) below grade. Tape shall be a minimum .127 mm (5 mil) plastic tape with metallic tracer, minimum 76 mm (3 inches) wide, lettering on tape to show buried utility, and brightly colored.

### 1.8.3 Access to Communications Manhole or Handhole

No communications manhole or handhole shall be entered without first obtaining a fiber optic cable briefing. Coordinate through the Contracting Officer with Joseph Brantingham, YTC, phone (509) 577-3212.

### 1.8.4 Cable Cuts or Damage

If a communications cable is cut or damaged the Contractor shall immediately notify the Contracting Officer (CO) and begin gathering personnel and equipment necessary to repair the cut, or damage. Contractor shall begin repairs within one hour of the cut or damage, unless notified otherwise, and continue repairs without interruption until full service is restored.

## 1.9 PROJECT SIGN

Contractor shall furnish and install one project sign in accordance with conditions hereinafter specified and layout shown on drawing No. 49s-40-05-15, Sheets 1 and 2, except Corps of Engineers' castle and Department of Army seal will be Government furnished. All letters shall be block type, upper case. Letters shall be painted as indicated using exterior-type paint. Sign shall be maintained in excellent condition throughout the life of job. Project sign shall be located as directed. Upon completion of project, sign shall be removed and shall remain the property of Contractor.

## 1.10 ELEVATED WORK AREAS

Workers in elevated work areas in excess of 2 meters (6 feet) above an adjoining surface require special safety attention. In addition to the

provisions of SAFETY AND HEALTH REQUIREMENTS MANUAL, EM 385-1-1, the following safety measures are required to be submitted to the Contracting Officer's Representative. Prior to commencement of work in elevated work areas, the Contractor shall submit drawings depicting all provisions of his positive fall protection system including, but not limited to, all details of guardrails. Positive protection for workmen engaged in the installation of structural steel and steel joist shall be provided by safety nets, tie-offs, hydraulic man lifts, scaffolds, or other required means. Decking crews must be tied-off or work over nets or platforms not over 2 meters (6 feet) below the work area. Walking on beams and/or girders and the climbing of columns is prohibited without positive protection. Perimeter guardrails shall be installed at floor, roof, or wall openings more than 2 meters (6 feet) above an adjoining surface and on roof perimeters. Rails shall be designed to protect all phases of elevated work including, but not limited to, roofing operations and installation of gutters and flashing. Rails around roofs may not be removed until all work on the roof is complete and all traffic on or across the roof ceases. Rails shall be designed by a licensed engineer to provide adequate stability under any anticipated impact loading. As a minimum, the rails shall consist of a top rail at a height of 1067 mm (42 inches), a mid-rail, and a toe board. Use of tie-offs, hydraulic man lifts, scaffolds, or other means of roof edge protection methods may be utilized on small structures such as family housing, prefabricated metal buildings, etc. If safety belts and harnesses are used, the positive fall protection plan will address fall restraint versus fall arrest. Body belts will ONLY be used for fall restraint, they will not be used for fall arrest.

#### 1.11 TRAFFIC CONTROL

The Contractor shall provide for movement of traffic through and around the construction zone in a manner that is conducive to the safety of motorists, pedestrians, and workers. This shall include placement and maintenance of traffic control devices in accordance with the U.S. Department of Transportation, Federal Highway Administration publication, Manual on Uniform Traffic Control Devices. Streets (except dead end) may be closed to traffic temporarily by approved written request to the Contracting Officer at least 10 working days prior to street closure. Street closures shall at all times allow street access to a building from one direction. Excavations shall not remain open for more than 1 working day without approval.

#### 1.12 UTILITIES NOT SHOWN

The Contractor can expect to encounter, within the construction limits of the entire project, utilities not shown on the drawings and not visible as to the date of this contract. If such utilities will interfere with construction operations, he shall immediately notify the Contracting Officer verbally and then in writing to enable a determination by the Contracting Officer as to the necessity for removal or relocation. If such utilities are removed or relocated as directed, the Contractor shall be entitled to equitable adjustment for any additional work or delay. The types of utilities the Contractor may encounter are waterlines, sewer lines (storm and sanitary), gas lines, fueling lines, steam lines, buried fuel tanks, septic tanks, other buried tanks, communication lines, and power lines. These utilities may be active or abandoned utilities.

#### 1.14 GOVERNMENT WITNESSING AND SCHEDULING OF TESTING

The Contractor shall notify the Contracting Officer, by serial letter, of dates and agenda of all performance testing of the following systems: mechanical (including fire protection and EMCS), electrical (including fire

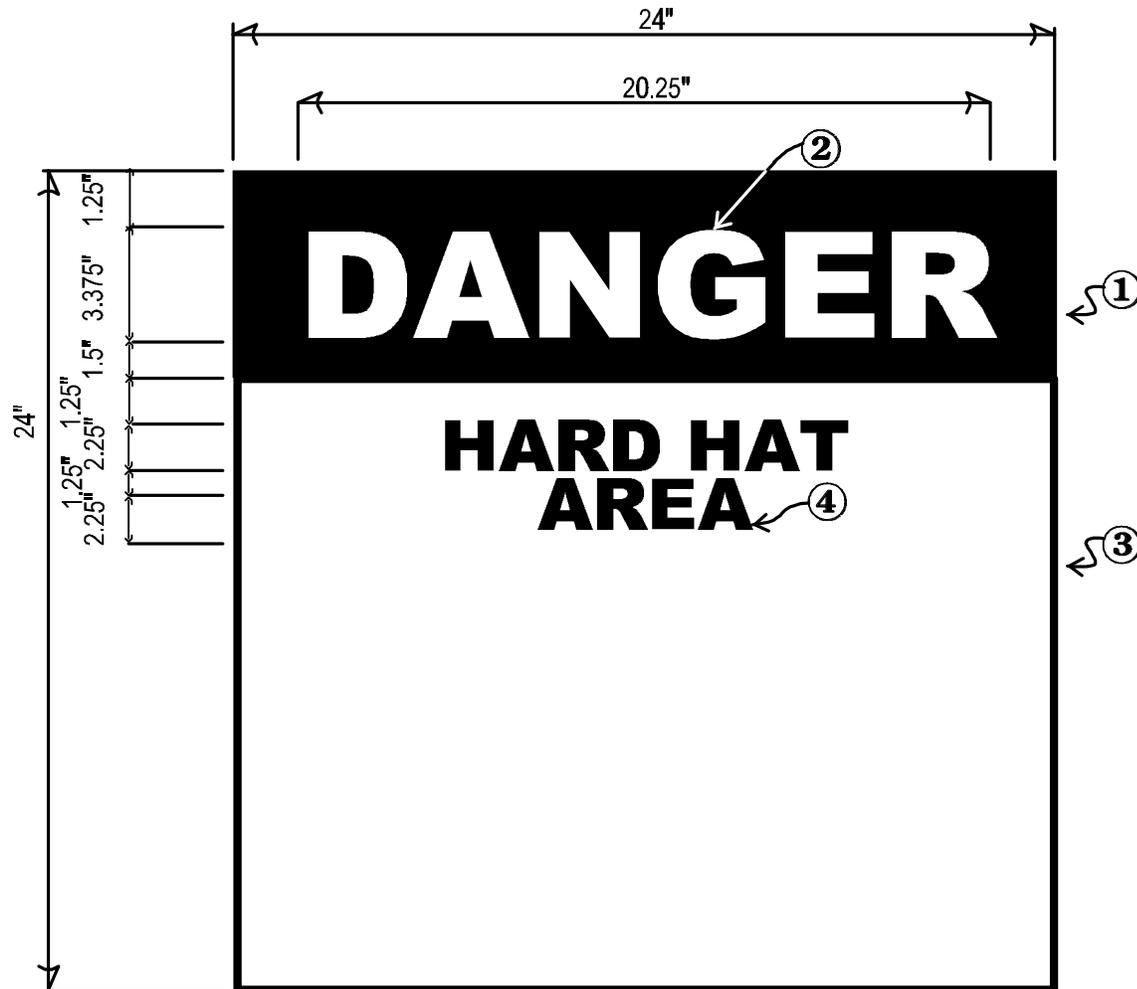
protection) medical and food service systems not later than 10 calendar days prior to start of such testing. In this notification, the Contractor shall certify that all equipment, materials, and personnel necessary to conduct such testing will be available on the scheduled date and that the systems have been prechecked by him and are ready for performance and/or acceptance testing. Contractor shall also confirm that all operations and maintenance manuals have been submitted and approved. NO PERFORMANCE AND/OR ACCEPTANCE TESTING WILL BE PERMITTED UNTIL THE OPERATIONS AND MAINTENANCE MANUALS HAVE BEEN APPROVED.

Government personnel, at the option of the Government, will travel to the site to witness testing. If the testing must be postponed or canceled for whatever reason not the fault of the government, the Contractor shall provide the Government not less than 3 working days advance notice (notice may be faxed) of this postponement or cancellation. Should this 3 working day notice not be given, the Contractor shall reimburse the Government for any and all out of pocket expenses incurred for making arrangements to witness such testing including, but not limited to airline, rental car, meal, and lodging expenses. Should testing be conducted, but fail and have to be rescheduled for any reason not the fault of the Government, the Contractor shall similarly reimburse the Government for all expenses incurred.

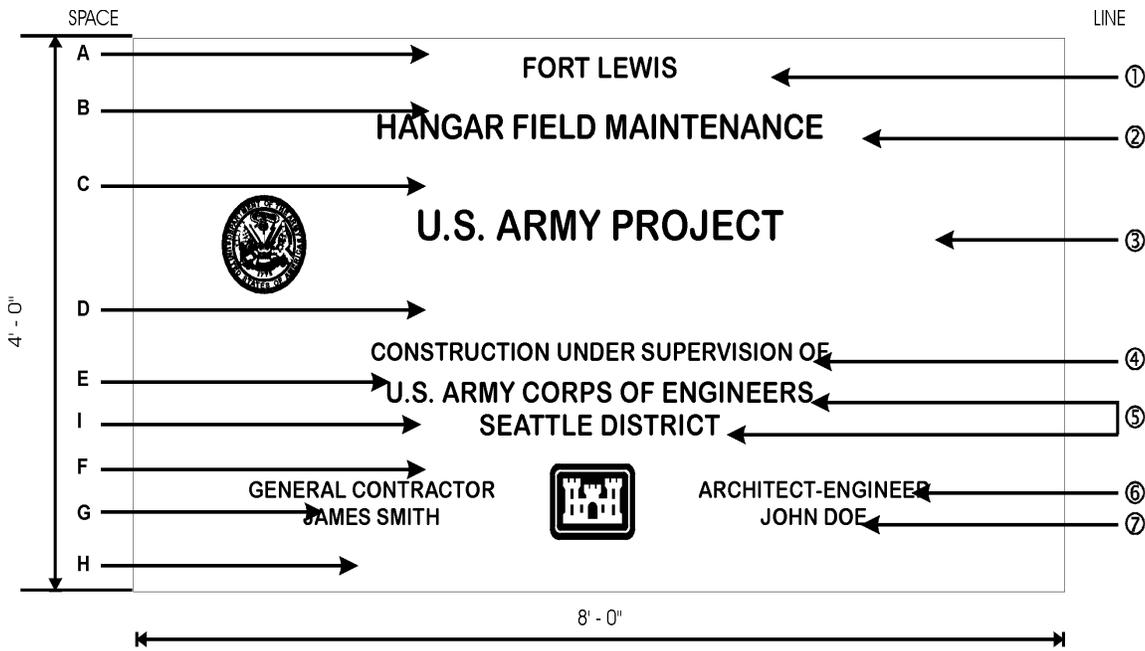
#### 1.15 HARD HAT SIGNS

The Contractor shall provide 610 mm by 610 mm (24 by 24 inch) square Hard Hat Area signs at each entry to the project or work area as directed by the Contracting Officer. A minimum of two signs will be required. Signs shall be in accordance with the sketch at the end of this section.

PART 2 PRODUCTS AND PART 3 EXECUTION (NOT APPLICABLE)



- SIGN SHALL BE FABRICATED FROM .125 THICK 6061-T6 ALUMINUM PANEL
- COLOR
  1. SAFETY RED (SR)
  2. WHITE
  3. WHITE
  4. BLACK
- LETTERING SHALL BE HELVETICA BOLD TYPOGRAPHY.
- LETTERS AND BACKGROUND SHALL BE REFLECTIVE SHEETING MATERIAL.
- SIGNS SHALL BE POSTED AT 6'-6" (BOTTOM SIGN TO GRADE) OR AS DIRECTED BY THE CONTRACTING OFFICER.
- LETTERING TO BE CENTERED ON PANEL.



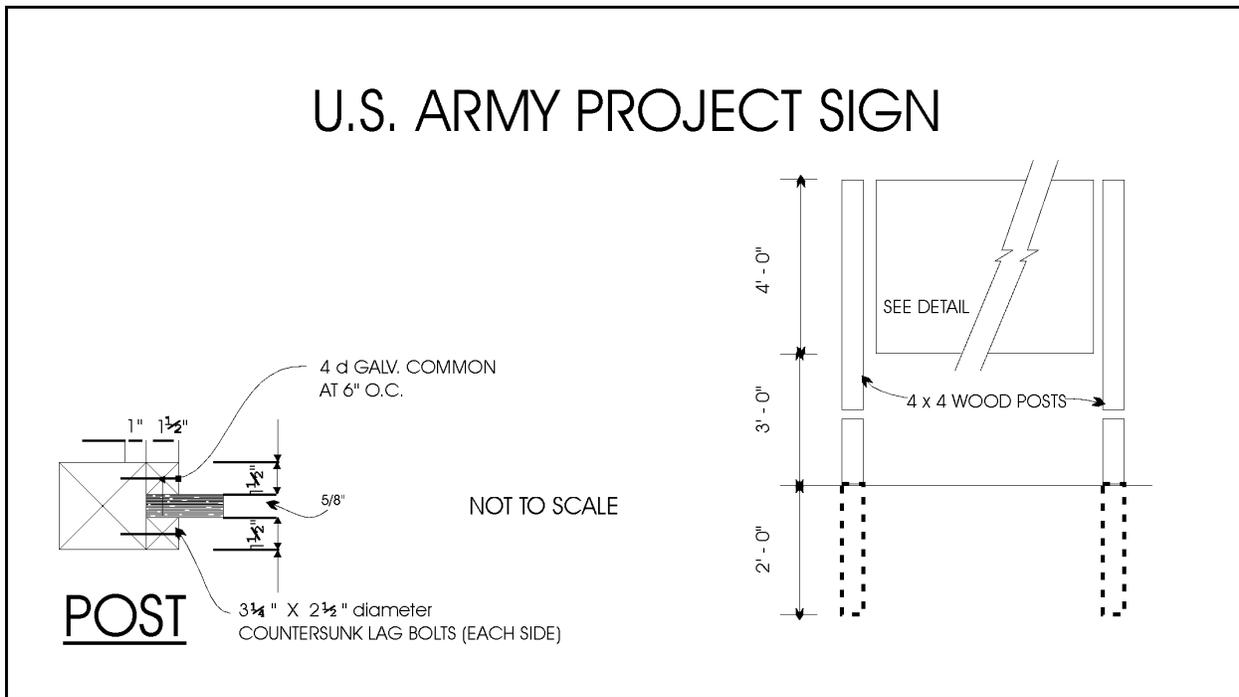
**SAMPLE CONSTRUCTION SIGN FOR MCP PROJECTS  
SCHEDULE**

SPACE	HT.	LINE	DESCRIPTION	LETTER HT.	STROKE
A	2"	1	LOCATION	2 3/8"	1/4"
B	2 5/8"	2	PROJECT NOMENCLATURE *	2 3/4"	3/8"
C	5 3/4"	3	U.S. ARMY PROJECT	4"	1/2"
D	8"	4	CONSTRUCTION UNDER SUP.	1 1/2"	1/8"
E	4"	5	CONSTRUCTION AGENCY *	2 3/8"	1/4"
F	4"	6	GENERAL CONTRACTOR *	1 3/8"	3/16"
G	1"	7	GENERAL CONTRACTOR*	1 3/8"	3/16"
H	2 7/8"	*	WILL VARY TO SUIT PROJECT REQUIREMENTS		
I	2		SEATTLE DISTRICT		

U.S. ARMY

**PROJECT  
CONSTRUCTION SIGN**

Sheet 1 of 2 Scales As shown  
U.S. Army Engr. Dist. Seattle, WA.  
Dr: R.L.W. Transmitted with report  
Tr: R.L.W. DATED: 20 JUNE 84  
Ck: R.L.W. File No. 49s/40-05-15



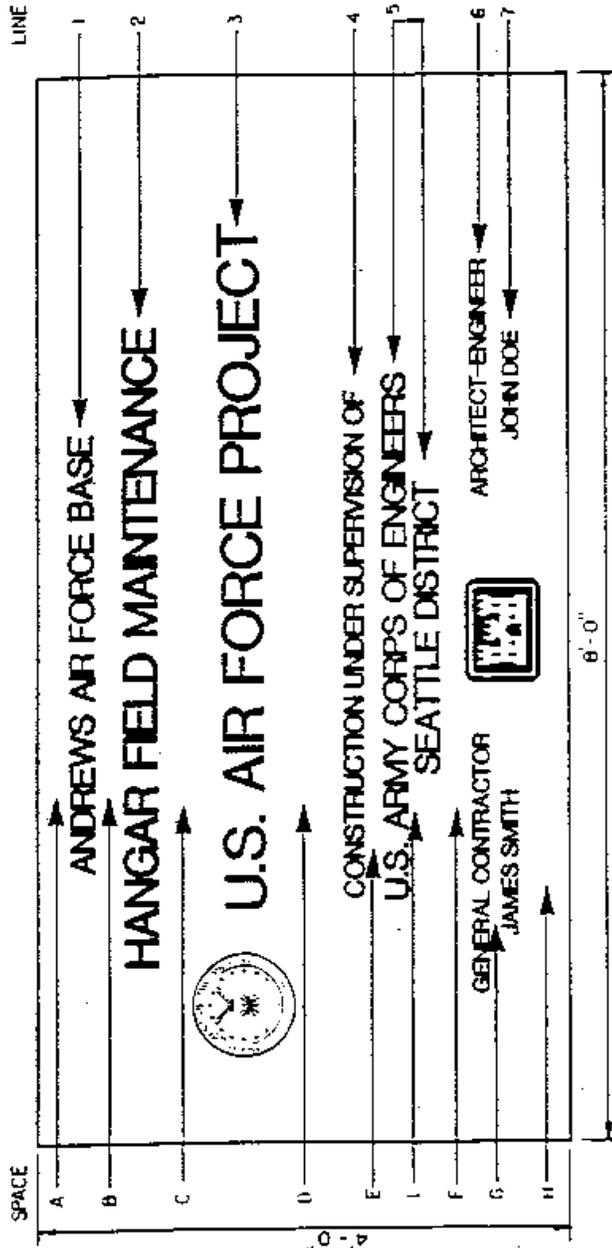
## NOTES:

1. Signboard 4' x 8' x 5/8" grade A-C exterior type plywood with medium density overlay on both sides.
2. Paint both sides and edges with one prime coat and two coats of paint, color white exterior type enamel. Lettering shall be as shown on drawing and shall be black gloss exterior type enamel.
3. Lettering shall be Helvetica medium.
4. Acceptable abbreviations may be used for Contractor's name.
5. Department of Army Seal and Corps of Engineers' Castle to be Government furnished.  
No company logo shall be used.  
Sign posts and 1 1/2" wood trim shall be painted white.
8. Upon completion of work under this contract, the project sign shall be removed from the job site and shall remain the property of the Contractor.

NOTE: The Contractor shall verify the colors to be used with the Contracting Officer prior to constructing the sign.

SHEET 2 OF 2

END OF SECTION



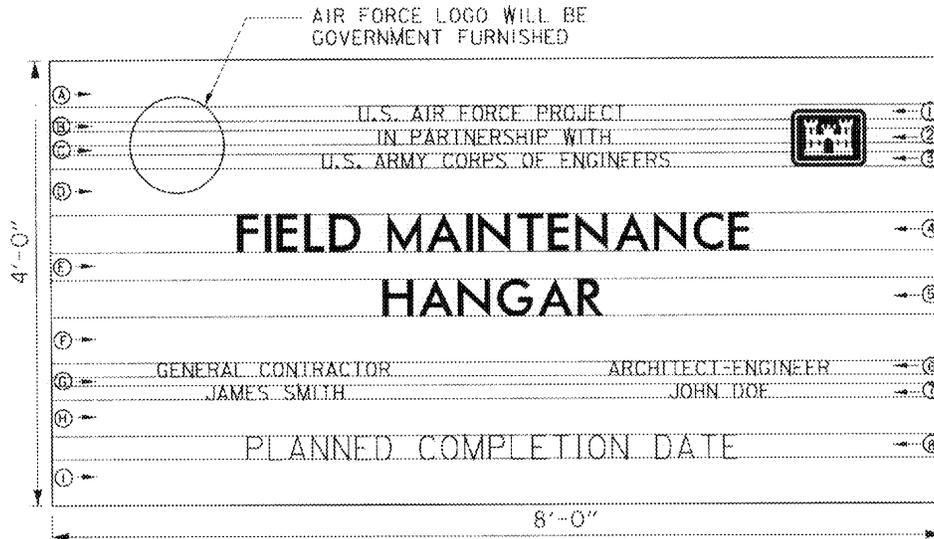
## SAMPLE CONSTRUCTION SIGN FOR MCP PROJECTS

### SCHEDULE

SPACE	HT.	LINE	DESCRIPTION	LETTER	STROKE
				HT.	
A	2"	1	LOCATION	2 3/8"	1/4"
B	2 5/8"	2	PROJECT NOMENCLATURE #	2 3/4"	3/8"
C	5 3/4"	3	U.S. AIR FORCE PROJECT	4"	1/2"
D	6"	4	CONSTRUCTION UNDER SUPERVISION OF	1 1/2"	1/8"
E	4"	5	CONSTRUCTION AGENCY #	2 3/8"	1/4"
F	4"	6	GENERAL CONTRACTOR #	1 3/8"	3/16"
G	1"	7	GENERAL CONTRACTOR	1 3/8"	3/16"
H	2 7/8"	8	ARCHITECT-ENGINEER	1 3/8"	3/16"
I	2"	9	ARCHITECT-ENGINEER	1 3/8"	3/16"

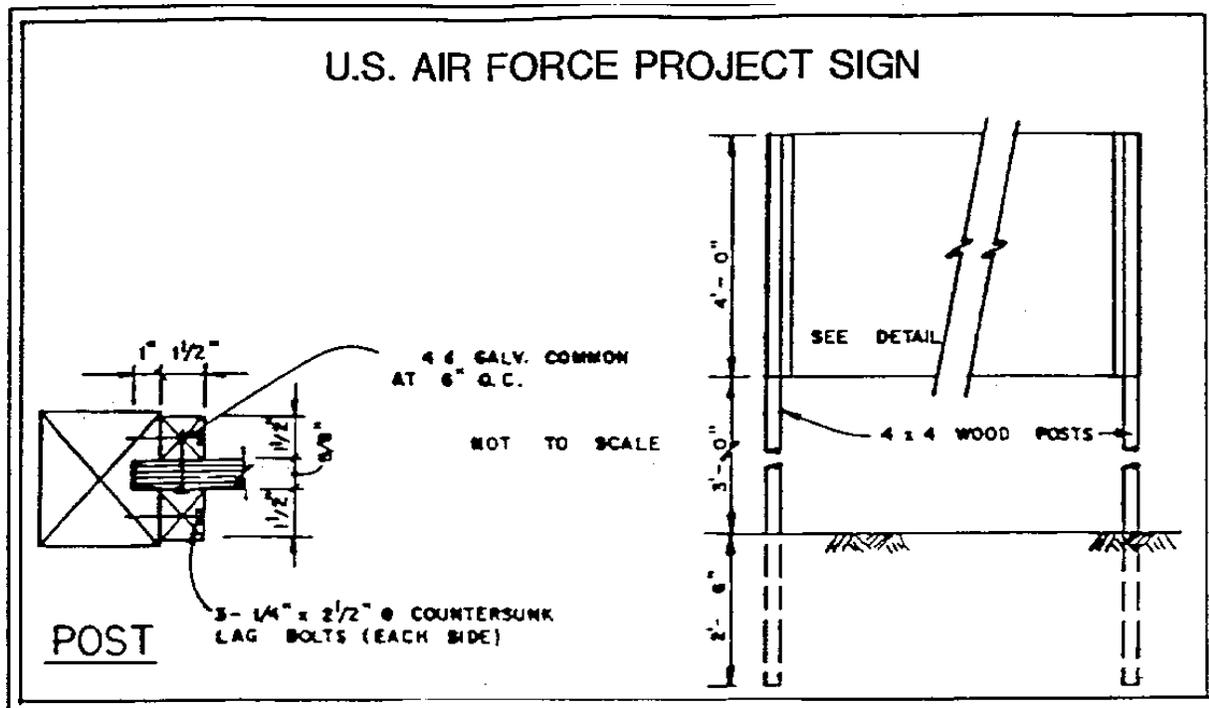
U.S. AIR FORCE  
PROJECT  
CONSTRUCTION SIGN

Sheet 1 of 2  
 48, Army Engineer, District, Seattle, WA.  
 Prepared and submitted with report  
 Tri-Service, DATED 20 JUNE 84  
 Col R.L.N., File No. 481/40-05-15



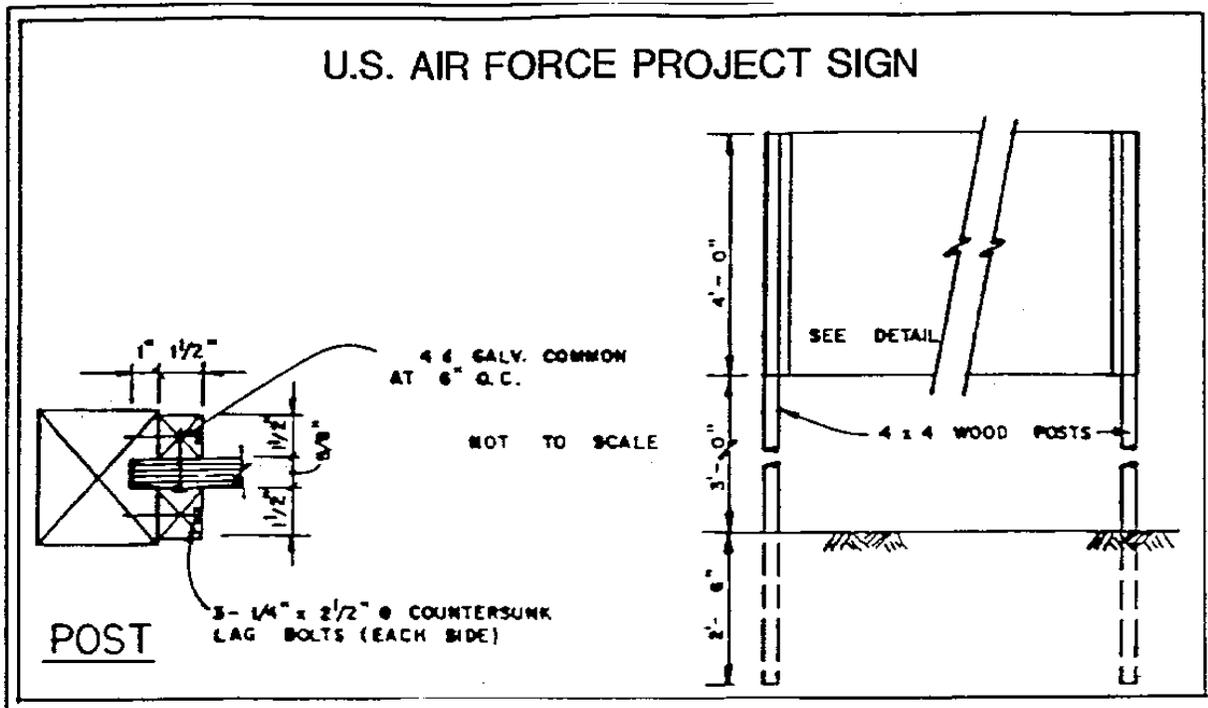
SAMPLE CONSTRUCTION SIGN FOR MILCON PROJECTS SCHEDULE					
SPACE	HEIGHT	LINE	DESCRIPTION	LETTER HEIGHT	STROKE
A	5"	1	U.S. AIR FORCE PROJECT	1 1/2"	3/16"
B	1"	2	IN PARTNERSHIP WITH	1 1/2"	3/16"
C	1"	3	U.S. ARMY CORPS OF ENGINEERS	1 1/2"	3/16"
D	5"	4	PROJECT NAME	4"	1/2"
E	3"	5	PROJECT NAME CONT'S (IF REQUIRED)	4"	1/2"
F	5"	6	GENERAL CONTRACTOR/A-E	1 1/2"	3/16"
G	1"	7	GENERAL CONTRACTOR/A-E	1 1/2"	3/16"
H	4"	8	PLANNED COMPLETION DATE	2 1/2"	1/4"
I	5"				

U.S. AIR FORCE  
**PROJECT CONSTRUCTION SIGN**  
 SHEET: 1 OF 2 SAMPLE AS SHOWN  
 U.S. ARMY ENGINEER DISTRICT, SEATTLE, WA  
 DR: L.T. DATE: 14 NOV 97  
 FILE NO: 49S/40-05-15



NOTES:

1. Signboard 4' x 8' x 5/8" grade A-C exterior type plywood with medium density overlay on both sides.
2. Paint both sides and edges with one prime coat and two coats of paint, accordance with FED. STD. 595b, color number dark brown 10055 exterior type enamel. Lettering shall be as shown on drawing and shall be FED. STD. 595b, color number white 17925 gloss exterior type enamel.
3. Lettering shall be Helvetica medium.
4. Acceptable abbreviations may be used for Contractor's name.
5. Department of Air Force Seal and Corps of Engineers' Castle to be Government furnished.
6. No company logo shall be used.
7. Sign posts and 1 1/2" wood trim shall be painted white.
8. Upon completion of work under this contract, the project sign shall be removed from the job site and shall remain the property of the Contractor.

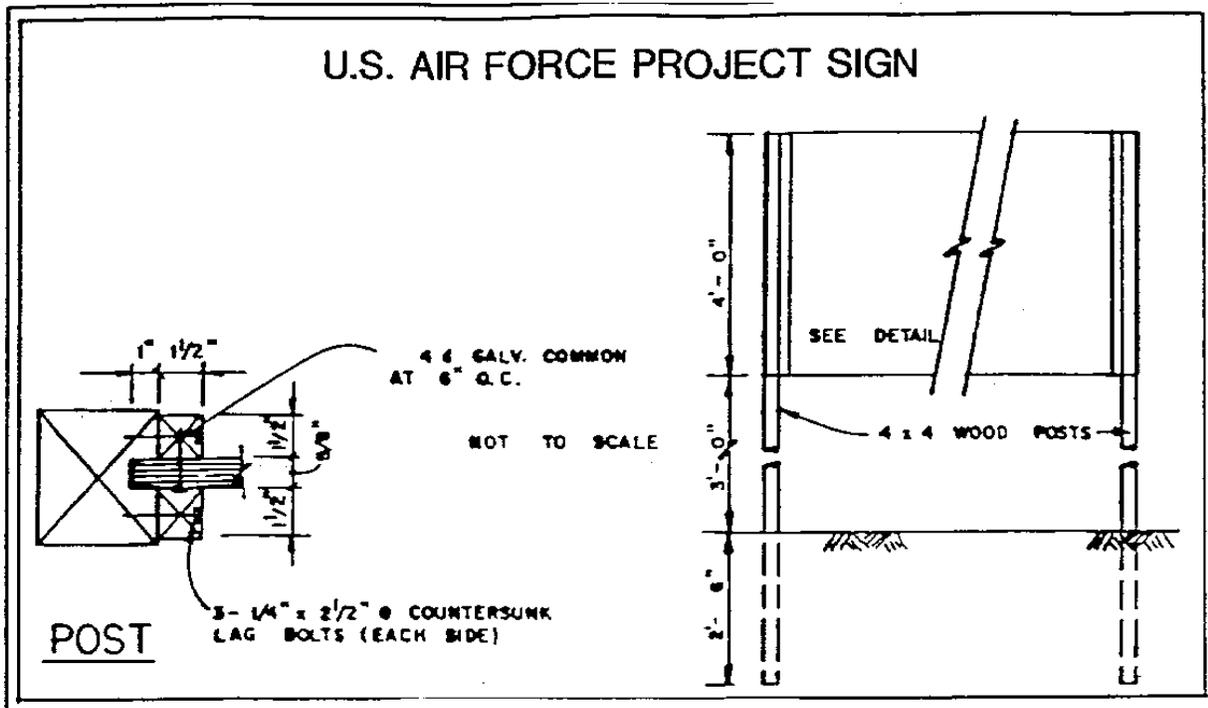


NOTES:

1. Signboard 4' x 8' x 5/8" grade A-C exterior type plywood with medium density overlay on both sides.
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3. Lettering shall be Helvetica medium.
4. Acceptable abbreviations may be used for Contractor's name.
5. Department of Air Force Seal and Corps of Engineers' Castle to be Government furnished.
6. No company logo shall be used.
7. Sign posts and 1-1/2" wood trim shall be stained dark brown.
8. Upon completion of work under this contract, the project sign shall be removed from the job site and shall remain the property of the Contractor.

END OF SECTION

SHEET 2 OF 2



NOTES:

1. Signboard 4' x 8' x 5/8" grade A-C exterior type plywood with medium density overlay on both sides.
2. Paint both sides and edges with one prime coat and two coats of paint, color white exterior type enamel. Lettering shall be as shown on drawing and shall be black gloss exterior type enamel.
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6. No company logo shall be used.
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8. Upon completion of work under this contract, the project sign shall be removed from the job site and shall remain the property of the Contractor.

END OF SECTION

SHEET 2 OF 2



## SECTION 01701

## OPERATIONS AND MAINTENANCE MANUALS

## PART 1 GENERAL

## 1.1 SUBMITTALS

Submittals shall be in accordance with SECTION 01300: SUBMITTALS. See paragraph 3.2A this Section for special O&M Manual requirements this contract.

## 1.1.1 Preliminary O&amp;M Manual And Data Submittal

To establish and assure uniform O&M manual format, the Contractor shall submit and receive Contracting Officer approval on one (1) complete set of O&M data without the binders prior to submission of the final bound manuals. Initial O & M Manual data submittal shall be a minimum of 30 days prior to 90 percent project completion.

The Contractor shall also provide two typewritten pages representing the proposed binder marking format as required under Paragraph: Marking and Binding. One page will represent the front cover/spine and the other page will represent the inside of the front cover.

1.1.1.1 Data submitted for the manual are to be for the specific equipment furnished, and are in addition to that furnished as shop drawings.

1.1.1.2 The Contracting Officer will require thirty (30) days for review of submitted O&M manual(s) or data. The Contracting Officer will retain one copy of unacceptable O&M manual submittal and return remainder of copies to the Contractor marked "Returned for Correction." If "Returned for Correction." the Contractor shall resubmit the required number of copies of the manual(s) incorporating all comments, prior to substantial completion and/or use and possession. The Contractor may, at his option, update the copy retained by the Government in lieu of providing the added copy.

## 1.1.2 Final O&amp;M Manual And Data Submittal

## 1.1.2.1 Number of Manuals

Six copies of the complete set of manuals shall be provided for each building (as identified by a building number or building description) for multi-building projects. For those multi-building projects where the work is identical in each building, one copy of the manual is required for each building plus six additional copies. For those projects that do not have work in specific buildings, six copies of the manuals are required for the complete project. Any project may have a combination of these requirements to determine the total number of copies required. The requirement for six copies of the O&M manual shall supersede and replace any requirements for a lesser amount of manuals which may be indicated in some specifications.

1.1.2.2 For equipment or systems requiring personnel training and/or acceptance testing, the final O&M data shall be approved by the Contracting Officer prior to the scheduling of the training and/or testing. O&M data on equipment or systems not requiring training or testing shall be submitted so all data will be approved and bound in the O&M manuals in the required quantity by the time the project reaches 90 percent completion. Failure to furnish approved, bound manuals in the required quantity by the time the project is 90 percent complete, will be cause for the Contracting Officer to hold or adjust the retained percentage in accordance with CONTRACT CLAUSE, PAYMENTS UNDER FIXED PRICE CONSTRUCTION CONTRACTS.

1.1.2.3 Three of the six completed copies of the final O&M manuals shall contain original manufacturer's data. Data in the remaining manuals may be duplicated copies of original data. All data furnished must be of such quality to reproduce clear, legible copies.

#### 1.1.2.4 Binders

##### 1.1.2.4.1 Construction and Assembly

Manuals shall be sliding posts or screw-type aluminum binding posts (three screws) with spine, but only one type shall be used for all manuals. The manuals shall be hardback plastic-covered, cleanable, not over three (3) inches thick and designed for 8-1/2 x 11 inch paper. The hard cover shall be of minimum stiffness equal to 0.080 inch display board or double weight illustration board.

##### 1.1.2.4.2 Marking and Binding

As appropriate, systems shall be grouped into four separate categories and bound into four volumes as follows: Mechanical, Electrical, Fire Protection/Security, and Architectural/General.

Each binder shall have the following information, as a minimum, inscribed on both the spine and cover using an offset or silk screen printing process; "EQUIPMENT OPERATION, MAINTENANCE, AND REPAIR MANUAL;" BUILDING NAME, IDENTIFICATION NUMBER (Building No.), LOCATION, AND DISCIPLINE (MECHANICAL, ELECTRICAL, FIRE PROTECTION/SECURITY, ARCHITECTURAL/GENERAL). Contractor's name and address as well as the contract title and contract number shall be printed on the inside of the front cover.

##### 1.1.2.4.3 Color

Color of binder and printing shall be the option of the Contractor except that; (a) printing color shall contrast with binder color, and (b) colors shall be the same for all manuals.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.1 GENERAL

The Contractor shall provide Operation and Maintenance (O&M) manuals for the complete project as applicable under this contract, including all Contractor furnished and installed equipment, systems and materials, and all Government furnished-Contractor installed equipment, systems and materials. Included herein are requirements for compiling and submitting the O&M data. Additional O&M data requirements are specified in the individual sections of the technical specifications. O & M Manual requirements shall be coordinated with the requirements as stated in the other technical specification sections and shall include listings for spare parts, framed instructions, etc.

#### 3.1.1 Preparation

Manual preparation shall be under the direction of an individual or organization that has demonstrated expertise and a minimum of 3 years experience in the preparation of comprehensive and complete O&M manuals. Qualifications shall be submitted for Contracting Officer approval.

#### 3.1.2 Format

O&M data shall be separated into distinct systems. O&M manuals for any particular system shall include narrative and technical descriptions of the interrelations with other systems. This narrative shall include a description on how the system works with notable features of the system, including normal and abnormal operating conditions. The explanation of the system is to be short and concise with reference to specific manufacturer's equipment manuals for details (see paragraph CONTENT, subparagraph b). If the quantity of material is such that it will not fit within one binder then it shall be divided into volumes, as required (see paragraph Binders).

### 3.2 CONTENT

The O&M manuals shall be structured to address each of the following topics in order for each system. When the topic does not apply to a particular system the topic name will be included in the manual with the words "DOES NOT APPLY."

a. Warning Page: A warning page shall be provided to warn of potential dangers (if they exist), such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, or high pressures. The warning page shall be placed inside the front cover, in front of the title page.

b. Index: Each manual shall have a master index at the front identifying all manuals and volumes and subject matter by system name for each. Following the master index, each manual shall have an index of its enclosures listing each volume, tab numbers, etc., as necessary to readily refer to a particular operating or maintenance instruction. Rigid tabbed fly leaf sheets shall be provided for each separate product and/or piece of equipment under each system in the manual. For example, if a system includes Air Handling Units 1 through 5, there shall be tab sheets AHU-1, AHU-2, AHU-3, AHU-4 and AHU-5. When a manual is divided into volumes, each volume shall have a master index at its front, followed by an index for the specific volume listing in detail all enclosed instructions for materials, individual pieces of equipment, and systems. All pages shall be numbered with the referenced number included in the index.

c. Description: Narrative and technical descriptions of the system and of the interrelations with other systems.

d. Check List Prior to Start Up: Precautions and prechecks prior to start up of equipment and/or system, including safety devices, monitoring devices and control sequence shall be provided.

e. Start Up and Operation: Step-by-step sequential procedures for start up and normal operation checks for satisfactory operation shall be provided. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and flagged for the attention of the operator. Procedures shall include test, manual or normal, and automatic modes.

f. Shutdown: Procedures for normal and emergency shutdown of equipment and/or systems shall be provided. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for start up at a later time. Procedures shall include test, manual or normal, and automatic modes.

g. Operator Preventive Maintenance, Major Maintenance, and Adjustments: The instructions shall include recommended operator preventive maintenance which would normally be performed by operating personnel and adjustment procedures necessary for normal operation. Schedules shall be provided indicating time frames or operating hours for initiating operator maintenance and adjustments, and including manufacturer's recommended major maintenance requirements. Emergency adjustments shall be included and flagged for operator's attention; the instructions shall also include procedures for

emergency repairs that could be performed by operating personnel. These emergency repairs or "trouble-shooting guides" shall be outlined in three columns with the following headings:

- Column 1 - Trouble
- Column 2 - Probable Cause(s)
- Column 3 - Correction

h. Operator Data: The instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, valves, dampers, controls, etc., complete with diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. Layouts shall show the location within the facility of controls, valves, switches, dampers, etc., by reference to site location, wing designation, floor, room number, or other clear and concise directions for locating the item. Operator data may be identical to posted data and framed instructions but shall be prepared as part of the O&M manuals. All control systems operations data shall include the following:

(1) A fully labeled control schematic which details all set points, throttling ranges, actions, spans, proportional bands, and any other adjustment.

(2) A fully labeled elementary diagram (ladder diagram).

(3) A sequence of control on the diagrams cross-referenced to the control schematic and elementary diagram.

(4) A generic, functional description of each control component shown on the drawings.

(5) Catalog data of every control device.

i. Electrical Layout Drawings: The Electrical O&M's shall include complete layout drawings and one-line diagrams of exterior and interior electrical with reference to the buildings and site layout. Drawings shall include layout of interior lighting, interior power, intrusion detection systems, communication systems and fire protection systems. Exterior layout drawings shall show where fed from, pad-mount transformer, metering, main distribution panel and communication lines. Layout drawings shall show the location within the facility or reference to the building and the site plan. Layout drawings shall be half size contract as-built drawings and shall be inserted into plastic pockets and installed at the back of the O&M's that pertain to that particular drawing.

j. Maintenance Procedures: Recommended procedures shall indicate preventive maintenance, lubrication, and good housekeeping practices which should be performed by operating personnel as well as more complex maintenance procedures which would normally be performed by trained maintenance personnel only. The procedures shall be presented with a schedule indicating time frames or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off line, putting equipment on line, or putting equipment on standby. The instructions shall include all necessary material, equipment, and system data to perform maintenance work and shall include, but not be limited to, manufacturers/bulletins, catalogs, and descriptive data; certified performance curves, copies of approved test plans, including logs and records of performance acceptance test results, and actual adjustments made during final acceptance and inspection; system layouts, including block diagrams, wiring, control and isometric diagrams, schematic items within the facility; and interrelationships with other items of system.

k. Repairs: Repair procedures shall be presented with a step-by-step procedure for locating and correcting the trouble. A "shop manual" may be used for this purpose. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Column 1 - Trouble  
Column 2 - Probable Cause(s)  
Column 3 - Correction

The procedures shall clearly indicate a major repair activity which should only be performed in a shop or factory versus normal repair work that may be performed on-site or with equipment on-line. The procedures shall also clearly indicate the limit of repair work that may be performed by Government personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

l. Tools: The Contractor shall provide one of each nonstandard tool, test instrument, and gauge necessary for performing maintenance and repair work. A nonstandard tool, test instrument, or gauge is defined as an item normally supplied by the manufacturer for the equipment operation or maintenance. The Contractor shall prepare a master list of such items for all equipment and systems and shall key maintenance and repair procedures to this list.

m. Parts and Supplies: A complete list of parts and supplies shall be provided with the maintenance instructions. The list shall include all parts and components of individual pieces of equipment, and all parts and components of each system and shall identify such items as description of part, model number, I circuit or component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of spare parts and supplies recommended from each manufacturer for 1 year of operation, including source of supply, shall be sublisted with each instruction.

(1) Availability: The Contractor shall list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, (within 6 hours travel time, round trip by surface transportation) necessary procurement time shall also be a part of the listing.

(2) Spare Parts: The Contractor shall provide those spare parts and supplies that are specified in the TECHNICAL SPECIFICATIONS and those which are normally provided with the equipment or material item. A separate master list shall be provided for these items upon turnover to the Government of the parts and supplies.

n. Maintenance Schedule: A separate schedule of all required periodic maintenance shall be included. This schedule shall list by frequency of occurrence all lubricants and special adjustments required. The types and amounts of lubrication must be specified. The Contractor shall verify that the furnished maintenance schedule agrees with the published manufacturer's data.

### 3.2A System Description and Procedures

(1) System Description: Provide general description of the facility to include a reduced scale drawing of the facility site plan, a description of the number and type of fueling lanes, fuel pits, filters, controls, control house, storage tanks, pumps, and any other salient feature. Provide a short paragraph description of each feature.

(2) System Checkout and Operating Preparations: Provide a step by step list of instructions for starting, inspecting, and operating the system. Describe the fuel circulation systems and provide a step by step list of instructions for fuel circulation operations. Provide a troubleshooting checklist for anticipated system malfunctions.

(3) Fueling Procedures: Provide a description of the facility staffing requirements and specific personnel functions for fueling operations. Provide a step by step list of instructions for accepting and issuing bulk and retail fuel. Describe hot refueling procedures. Detail the fuel pump sequence of operations.

(4) Control System: Provide an overview of system controls, diagram control equipment, and explain the control functions of each piece of equipment. Describe emergency shut down procedures, loop circulation system, and system annunciation and indication systems.

(5) Manual Operation: Describe system set-up for manual operation. Describe manual fueling procedures.

(6) Securing the System: Provide recommended procedures for shutting the system down overnight, and for extended periods of time.

(7) Control System Trouble Shooting: Provide a detailed trouble shooting guide for identifying and correcting control system problems. Procedures to address communications link failures, control equipment failures, pump failures, filter equipment failures, false process alarms, proper reset procedures, and any other source of possible system operation failure.

(8) Emergency Procedures: Provide instructions for fire emergency procedures and fuel spill emergency procedures.

(9) System Components, Their Operation and Maintenance: Provide specific equipment catalog cuts and maintenance instruction for each piece of system equipment. Provide a consolidated, recommended maintenance schedule for fuel station equipment.

### 3.2.1 Architectural/General O&M

(1) Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products. Data shall include, but not be limited to, information on carpet, floor tile, vinyl wall finishes, builder's hardware, etc.

(2) Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

(3) Moisture-Protection and Weather-Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

(4) Additional Requirements: As specified in individual specifications sections.

### 3.2.2 Warranties

In addition to the general warranty required by the contract, the O&M manuals shall include any specific warranties required by other sections of the TECHNICAL SPECIFICATIONS and other warranties normally provided with the particular piece of equipment or system. Extended warranties normally provided by manufacturers that are beyond the warranty of construction shall be specifically noted. The O&M manuals shall also include a specific warranty section itemizing all standard and extended warranty items. The warranty list shall be as indicated below. Warranties will not begin until the facility is accepted by the Contracting Officer. Copy of warranty shall be included in the manual.

## WARRANTY INFORMATION

Project Title  
Contract Number

General Contractors Name, Phone Number

<u>ITEM DESCRIPTION</u>	<u>START DATE</u>	<u>END DATE</u>	<u>O &amp; M REFERENCE LOCATION</u>
-------------------------	-------------------	-----------------	-------------------------------------

(in alphabetical order)

Descriptive Name,  
Manufacturers/  
Warrantors Name  
Address & Phone No.

### 3.2.3 Installed Equipment Lists

A copy of the completed Equipment in Place forms required in SECTION 01705: EQUIPMENT-IN-PLACE shall be included in the manual. The completed forms shall be located at the front of the catalog and O&M data for the equipment listed on the form.

### 3.2.4 Data Layout

(1) Data Identification: Catalog data shall be marked to clearly identify pertinent data by highlighting the data with pointers or crossing out all nonpertinent data.

(2) Drawings: All drawings bound in the manuals shall be of such size that will require only one fold made right to left. All larger size drawings shall be inserted into a separate pocket in the required location in the manual. All drawings shall be of microfilm quality.

### 3.3 POSTED DATA

The Contractor shall provide posted data for equipment or systems, in addition to O&M manuals, and as required by other Technical Specifications sections. The data shall consist of as-built schematics of all wiring, controls, piping, etc., as necessary for the operation of the equipment or system, and a condensed typewritten description of the system. The posted data may include approved shop drawings, layout drawings, riser, and block diagrams and shall indicate all necessary interrelation with other equipment and systems. The data may be presented in one or several frames, under glass or sheet acrylic glazing, for clarity and convenience of location. The framed data presentation and outline shall be acceptable to and posted at locations designated by the Contracting Officer. The data shall be posted before personnel training or performance testing acceptance for the related items of equipment or system.

### 3.4 FRAMED INSTRUCTIONS

Typewritten instructions, framed under glass or sheet acrylic glazing, explaining equipment or system prestart checkout, startup, operations and shutdown procedures, safety precautions, preventive maintenance procedures, and normal operation checks for satisfactory performance of the equipment of systems shall be posted in conjunction with the posted data. The framed instructions may be presented in one or several frames for clarity and convenience of location. The instruction presentation and outline shall be acceptable to the Contracting Officer prior to posting, and shall be posted at locations designated by the Contracting Officer. All framed instructions

shall be posted before personnel training or performance testing acceptance commences for the related item of equipment or system.

### 3.5 PAYMENT

No separate payment will be made for the preparation and submittal of O&M manuals. All costs incurred by the Contractor in the preparation and submittal of O&M manuals shall be considered as part of the price for the equipment and included in the contract price. Approval and acceptance of the final O&M manuals shall be accomplished before final payment is made to the Contractor.

### 3.6 CHECKLIST

Contractor shall complete and initial a copy of the O&M Manual Check List which is provided at the end of this section, and forwarded along with ENG Form 4025 as part of the O&M Manual submittal to the Contracting Officer for approval.

## O&amp;M MANUAL - REVIEW CHECKLIST

\_\_\_\_\_ Does the manual cover all equipment furnished under the contract? (Review against equipment schedules on the drawings and/or equipment submittals.)

\_\_\_\_\_ Does the manual clearly highlight all relevant portions or cross out all irrelevant portions of catalog data?

\_\_\_\_\_ Does the manual contain operations data for the equipment? (Step-by-step operating instructions, start up procedures, sequences of operation, precautions.)

\_\_\_\_\_ Does the manual contain maintenance and repair data for the equipment? (Lubrication, dismantling, assembly, adjustment, troubleshooting.)

\_\_\_\_\_ Does the manual contain a separate maintenance schedule listed by frequency of occurrence?

\_\_\_\_\_ Does the manual contain parts lists or parts catalogs for the equipment? Parts catalog or list shall contain identification, part numbers, recommended parts to be stocked, and local source of parts.

\_\_\_\_\_ Does the manual contain electrical connection diagrams?

\_\_\_\_\_ Does the manual contain control and interlock system diagrams where applicable?

\_\_\_\_\_ Is every page in the manual numbered and an index provided for ready reference to the data?

\_\_\_\_\_ Is the cover hard (nonflexible) with the facility name, identification number, location, and system embossed on both the spine and cover? Is the Contractor's name and address, and the contract title and contract number embossed on the inside of the manual cover?

\_\_\_\_\_ Is the binding screw posts or sliding post?

\_\_\_\_\_ Is any of the data in the manual under the binding where it cannot be seen?

\_\_\_\_\_ Do three sets of manuals contain all original data sheets and are others clearly legible?

\_\_\_\_\_ Are system layout drawings provided? (Simplified diagrams for the system as installed.)

\_\_\_\_\_ Are all drawings in the manual of such a size that requires one fold right to left, or if a larger size drawing, then inserted into a pocket in the manual?

Note that the above are common requirements to all contracts. Check the specific contract for additional information.

END OF SECTION

SECTION 01702  
AS BUILT RECORDS AND DRAWINGS

## PART 1 GENERAL

## 1.1 SUBMITTALS

Data listed in PART 3 of this section shall be submitted in accordance with section 01300 SUBMITTALS. Due dates shall be as indicated in applicable paragraphs and all submittals shall be completed before final payment will be made.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 AS-BUILT FIELD DATA

## 3.1.1 General

The Contractor shall keep at the construction site a complete set of full size blueline prints of the contract drawings, reproduced at Contractor expense. During construction, these prints shall be marked to show all deviations in actual construction from the contract drawings. The color red shall be used to indicate all additions and green to indicate all deletions. The drawings shall show the following information but not be limited thereto:

- a. The locations and description of any utility lines and other installations of any kind or description known to exist within the construction area. The location includes dimensions and/or survey coordinates to permanent features.
- b. The locations and dimension of any changes within the building or structure, and the accurate location and dimension of all underground utilities and facilities.
- c. Correct grade or alignment of roads, structures, and utilities if any changes were made from contract plans.
- d. Correct elevations if changes were made in site grading from the contract plans.
- e. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including, but not limited to, fabrication erection, installation, and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.
- f. The topography and grades of all drainage installed or affected as part of the project construction.
- g. All changes or modifications from the original design and from the final inspection.
- h. Where contract drawings or specifications allow options, only the option actually used in the construction shall be shown on the as-built drawings. The option not used shall be deleted.

These deviations shall be shown in the same general detail utilized in the contract drawings. Marking of the prints shall be pursued continuously during construction to keep them up to date. In addition, the Contractor shall maintain full size marked-up drawings, survey notes, sketches, nameplate data,

pricing information, description, and serial numbers of all installed equipment. This information shall be maintained in a current condition at all times until the completion of the work. The resulting field-marked prints and data shall be referred to and marked as "As-Built Field Data," and shall be used for no other purpose. They shall be made available for inspection by the Contracting Officer's representative whenever requested during construction and shall be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the Contractor prior to submission of each monthly pay estimate. Failure to keep the As-Built Field Data (including Equipment-in-Place lists) current shall be sufficient justification to withhold a retained percentage from the monthly pay estimate.

### 3.1.2 Submittal of the As-Built Field Data

The As-Built Field Data shall be submitted to the Contracting Officer for review and approval a minimum of 20 calendar days prior to the date of final inspection. If review of the preliminary as-built drawings reveals errors and/or omissions, the drawings will be returned to the Contractor for corrections. The Contractor shall make all corrections and return the drawings for backcheck to the Contracting Officer within 10 calendar days of receipt. When submitted drawings are accepted, one set of marked drawings will be returned to the Contractor for the completion of the as-built drawings.

## 3.2 AS-BUILT ELECTRONIC FILE DRAWINGS

3.2.1 No earlier than 30 days after award the Government will have available for the Contractor one set of AutoCAD electronic file format contract drawings, to be used for preparation of as-built drawings. The electronic file drawings will be available on either 3-1/2 inch 1.44 MB floppy disks or ISO-9660 CD-ROM, as directed by the Contracting Officer. The Contractor has 15 days after the receipt of the electronic file to verify the usability of the AutoCAD files, and bring any discrepancies to the attention of the Contracting Officer. Any discrepancies will be corrected within 15 days and files returned to the Contractor. The Contractor shall incorporate all deviations from the original contract drawings as recorded in the approved 'As-built Field Data' (see paragraph 3.1.2). All revisions and changes shall be incorporated, i.e. items marked "deleted" shall be deleted, new items shall have no clouds, etc.

3.2.2 No later than 30 days after final acceptance a complete set of as-built drawings shall be submitted in AutoCAD electronic file format. The electronic file format, layering standards and submittal requirements are specified in paragraphs below. The as-built drawings shall be done in a quality equal to that of the originals. Line work, line weights, lettering, and use of symbols shall be the same as the original line work, line weights, and lettering, and symbols. If additional drawings are required they shall be prepared in electronic file format under the same guidance. When final revisions have been completed, each drawings shall be identified with the words "AS-BUILT" in block letters at least 3/8-inch high placed above the title block if space permits, or if not, below the title block between the border and the trim line. The date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the latest revision notation.

### 3.2.3 Electronic File Submittal Requirements

3.2.3.1 The AutoCAD electronic file(s) deliverable shall be in AutoCAD release 12 'DWG' binary format. All support files required to display or plot the file(s) in the same manner as they were developed shall be delivered along with the files. These files include but are not limited to Font files, Menu files, Plotter Setup, and Referenced files.

3.2.3.2 Layering shall conform to the guidelines defined by the American Institute of Architects (AIA) standard document, "CAD Layer Guidelines" , Copyright 1990. An explanatory list of which layer is used at which drawing and an explanatory list of all layers which do not conform to the standard AIA CAD Layer Guidelines including any user definable fields permitted by the guidelines shall be provided with each submittal.

3.2.3.3 Electronic File Deliverable Media: All electronic files shall be submitted on ISO 9660 format CD-ROM. Two complete sets of disks shall be submitted along with one complete set of prints taken from the disks. Each disk shall have a clearly marked label stating the Contractor's firm name, project name and location, submittal type (AS-BUILT), and date. Each submittal shall be accompanied by a hard copy transmittal sheet that contains the above information along with a tabulated information about each file, as shown below:

<u>Electronic File Name</u>	<u>Plate Number</u>	<u>Drawing Title</u>
-----------------------------	---------------------	----------------------

#### 3.2.4 Submittal of the Final As-Built Drawings

Two sets of the final as-built record drawings shall be completed and returned | together with the approved preliminary as-built drawings to the COE, Seattle District Office, Survey Branch, Engineering Records, within 30 calendar days of final acceptance. All drawings from the original contract drawings set shall be included, including the drawings where no changes were made. The Government will review all final as-built record drawings for accuracy and conformance to the drafting standards and other requirements contained in DIVISION 1 GENERAL REQUIREMENTS. The drawings shall be returned to the Contractor if corrections are necessary. The Contractor shall make all corrections and shall return the drawings to the same office within 7 calendar days of receipt.

3.3 All costs incurred by the Contractor in the preparation and furnishing of as-built drawings in AutoCAD electronic file format shall be included in the contract price and no separate payment will be made for this work. Approval and acceptance of the final as-built record drawings shall be accomplished before final payment is made to the Contractor.

3.4 One set of marked-up as-built blue-line prints shall be furnished at the time of system acceptance testing. These as-built blue-line prints shall be in addition to the submittals of marked-up as-built blue-line prints specified elsewhere in the contract.

END OF SECTION

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## SECTION 01703

## WARRANTY OF CONSTRUCTION

## PART 1 GENERAL

## 1.1 SUBMITTALS

Submittals shall be made in accordance with SECTION 01300: SUBMITTALS. Submittal dates shall be as defined in PART 3 of this section.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 WARRANTY OF CONSTRUCTION (APR 1984) (FAR52.246-21):

3.1.1 In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph 3.1.9 of this Clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

3.1.2 This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

3.1.3 The Contractor shall remedy at the Contractor's expense, any failure to conform, or any defect. In addition, the Contractor shall remedy, at the Contractor's expense, any damage to Government-owned or controlled real or personal property, when that damage is the result of:

- a. the Contractor's failure to conform to contract requirements or
- b. any defect of equipment, material, workmanship, or design furnished.

3.1.4 The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

3.1.5 The Government will notify the Contractor, in writing or by telephone, after the discovery of any failure, defect, or damage and the Contractor shall respond and be on-site to investigate the problem within 1 working day after notification. The Contractor shall furnish, and maintain, a 24 hour emergency telephone number as the point of contact. For failures, defects, or damage causing loss of power or heat, the Contractor shall respond and mitigate problem within 4 hours.

3.1.6 If the Contractor fails to remedy any failure, defect, or damage within 5 working days after receipt of notice, the Government will have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

3.1.7 With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall:

- a. obtain all warranties that would be given in normal commercial practice;

b. require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

c. enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

3.1.8 In the event the Contractor's warranty under paragraph 3.1.2 of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

3.1.9 Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

3.1.10 This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

3.1.11 After final acceptance of the work, the Contractor shall furnish and install an Equipment Warranty Sticker on Contractor-installed equipment. (Same equipment as listed on the Equipment-In-Place List required under Section 01705.) Lettering shall be block-type upper case and easily readable. Sticker shall be of a durable type material and of a type that can be written on. Sticker shall state the following:

- a. The title "Equipment Warranty."
- b. Contractor's name and Contract Number.
- c. Date warranty expires.
- d. Point of contact, including name and telephone number.
- e. Manufacturer.

3.1.12 Defects in design or manufacture of equipment specified by the Government on a "brand name and model" basis shall not be included in this warranty. In this event, the Contractor shall require the subcontractors, manufacturers, or suppliers thereof to execute their warranties, in writing, directly to the Government.

END OF SECTION

SECTION 01704  
FORM 1354 CHECKLIST

PART 1 GENERAL

1.1 Procedures

The form which is a part of this specification section shall be completed for any project having revisions to real property. The following page contains the basic instructions applicable to the form.

1.2 Submittal

This form shall be submitted for approval, and be approved a minimum of 21 days before final inspection of the project. Failure to have this form completed and approved in time for the final inspection will result in delay of the inspection until the checklist is completed.

PARTS 2 AND 3 NOT USED

**INSTRUCTIONS FOR DD FORM 1354 CHECKLIST**

The following checklist is only a guide to describe various parts of new and modified construction. Alter this form as necessary or create your own document to give complete accounting of the real property added or deleted for this contract. All items added, deleted, replaced, or relocated within the building 5 foot line, or on site 5 feet beyond the building perimeter must be accounted for completely. Only a few of the most common items beyond the 5 foot line are included on the checklist under UTILITIES/SURFACE CONSTRUCTION, add additional items as required by the construction accomplished.. Attach a continuation sheet and use the checklist format to describe other work related to this particular project. Listed on the last page are additional items with units of measure and descriptive terms.

Costs for each item must include material, tax, installation, overhead and profit, bond and insurance costs. This form should be filled out as each item is installed or each phase of work is completed.

TOTAL FOR ALL ITEMS INCLUDING CONTRACT MODIFICATION COSTS ADDED TOGETHER SHOULD EQUAL THE TOTAL CONTRACT PRICE.

## KEY TO ABBREVIATIONS

AC - Acres  
BL - Barrels, Capacity  
BTU - British Thermal Unit  
CY - Cubic Yards  
EA - Each  
GA - Gallons, Capacity  
HD - Head  
KV - Kilovolt-Amperes, Capacity (KVA)  
KW - Kilowatts, Capacity  
SE - Seats  
SF - Square Feet  
SY - Square Yard  
MB - Million British Thermal Units  
MI - Miles  
LF - Linear Feet  
KG - Thousand Gallons Per Day, Capacity  
TN - Ton  
# - Number; How Many

**DD FORM 1354 CHECKLIST**

## Transfer of Real Property

CONTRACT NUMBER: \_\_\_\_\_

CONTRACT TITLE: \_\_\_\_\_

LOCATION: \_\_\_\_\_

1. **DEMOLITION** (Describe each item removed and the cost of removal.)\*2. **RELOCATION** (Describe each item relocated and the cost of relocation.)\*3. **REPLACEMENTS** (Describe each item replaced and replacement cost.)\*

\*Use a continuation sheet if more space is required. Items should be described by quantity and the correct unit of measure.

4. **NEW CONSTRUCTION OVERVIEW: BUILDING(S)/ADDITION(S) TO A BUILDING** - Use a separate checklist for each building and/or addition.

(1) **Outside Dimensions: Length x Width**

- (a) Main Building\_\_\_\_\_
- (b) Offsets\_\_\_\_\_
- (c) Wings\_\_\_\_\_
- (d) Basement\_\_\_\_\_
- (e) Attic\_\_\_\_\_

(2) **Number of Usable Floors:** \_\_\_\_\_

(3) **Construction: Exterior Materials Used**

- (a) Foundation (such as concrete)\_\_\_\_\_
- (b) Floors (such as wood, concrete)\_\_\_\_\_
- (c) Walls (such as wood siding, metal, CMU)\_\_\_\_\_
- (d) Roof (such as metal, comp., built-up)\_\_\_\_\_

(4) **Utilities ENTERING Building:** Measure LF from Bldg entry to next larger size of pipe

- (a) Water (size & type of pipe; number of LF)\_\_\_\_\_
- (b) Gas (size & type of pipe; number of LF)\_\_\_\_\_
- (c) Sewer (size & type of pipe; number of LF)\_\_\_\_\_
- (d) Electric (phase, voltage, size & type of wire, connected load in amps)\_\_\_\_\_

(5) **Air Conditioning:**

- (a) Type\_\_\_\_\_
- (b) Capacity (TONS)\_\_\_\_\_
- (c) SQ YDS covered by system\_\_\_\_\_

(6) **Heating:**

- (a) Source\_\_\_\_\_
- (b) Fuel\_\_\_\_\_

(7) Hot Water Facilities:

- (a) Capacity (GAL) \_\_\_\_\_
- (b) Temperature Rise \_\_\_\_\_

BUILDING COST: \_\_\_\_\_

5. BUILDING SYSTEMS (INTERIOR)

A. FIRE PROTECTION:

Property Code

(1) (880 50/880-211) CLOSED HEAD AUTO SPRINKLERS - SF & HD (wet or dry pipe; # of LF of service pipe; type of pipe & # of heads; # of SF covered by system) DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(2) (880 50/880-212) OPEN HEAD DELUGE SYSTEM - SF & HD (# of LF of service pipe; type of pipe; # of heads; # of SF covered) DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(3) (880 10/880-221) AUTO FIRE DETECTION SYSTEM - SF & EA (# of alarms-horns, bells, etc.; # of smoke detectors; # of heat detectors; # of fire alarm panels; # of radio transmitters/antennae) DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(4) (880 20/880-222) MANUAL FIRE ALARM SYSTEM - EA (# of pull stations; # of alarm horns; # of fire extinguisher cabinets) DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(5) (880 60/880-231) CO2 FIRE SYSTEM (# of bottles & size of bottles in lbs) DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(6) (880 60/880-232) FOAM FIRE SYSTEM - EA (# of tanks - capacity in lbs) DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(7) (880 60/880-233) OTHER FIRE SYSTEM - EA

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(8) (880 60/880-234) HALON 1301 FIRE SYSTEM - EA (# of bottles & size of bottles in lbs)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

**B. SECURITY:**

(1) (880 40/872-841) SECURITY ALARM SYSTEM - EA (name of system installed)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

**C. HEATING/COOLING SYSTEMS**

(1) (826 10/890-126) A/C WINDOW UNITS - TN & SF-(# of units installed; amount of SF

covered per unit; size & capacity of each unit)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(2) (826 14/890-125) A/C PLT LESS THAN 5 TN - TN & SF-(# of TN; # of SF covered)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(3) (826 13/890-121) A/C PLT 5 TO 25 TN - TN-(# of TN; # of SF covered)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(4) (826 12/826-122) A/C PLT 25 TO 100 TN - TN-(# of TN; # of SF covered)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(5) (826 11/826-123) A/C PLT OVER 100 TN - TN-(# of TN; # of SF covered)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(6) (821 33/821-115) HEATING PLT 750/3500 MB - MB-(# of MBH; type of heating system - Ex: Warm air furnace, central)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(7) (821 32/821-116) HEATING PLT OVER 3500 MB - MB-(# of MBH; type of heating system)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(8) (811 60/811-147) ELEC EMERGENCY POWER GENERATOR-KW-(size of engine; rating of generator in kilowatts & voltage)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(9) (81190 or 82320-gas) STORAGE TANK FOR HEATING or GENERATOR FUEL-GA; TYPE; FUEL-(Size, type of tank, kind of fuel & # of gallons)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

**SITE WORK**

**6. UTILITIES/SURFACE CONSTRUCTION:**

(1) (812 41/812-223) PRIM DISTR LINE OH-LF-(# LF of wire; size & type of wire; # of poles; voltage)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(2) (812/81360) TRANSFORMERS-KVA  
POWER POLES-LF  
(# poles; # transformers - pad or pole mounted; KVA of wire; # LF of wire)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(3) (812 40/812-224) SEC DISTR LINE OH-LF-(voltage; size & type of wire; # transformers; KVA; # LF of wire; # of service drops; # poles)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(4) (812 42/812-225) PRIM DISTR LINE UG-LF-(KVA; voltage; type of conduit & size(encased or direct burial); size & kind of wire inside conduit; LF of wire & conduit)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(5) (812 42/812-226) SEC DISTR LINE UG-LF-(type of conduit & size; type & size of wires in conduit; LF of conduit & wire inside conduit; voltage)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(6) (812 30/812-926) EXTERIOR LIGHTING-EA-(streets or parking area lights) (# & type of lights; whether pole mounted or not; # LF of connecting wire if pole mounted)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(7) (824 10/824-464) GAS MAINS-LF(size, type, & # of LF of pipe)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(8) (831 90/831-169) SEWAGE SEPTIC TANK-KG-(size, kind of material, & capacity)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(9) (832 10/832-266) SANITARY SEWER-LF-(sizes & types of pipes - # of LF of each; # of cleanouts; # & size of manholes)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(10) (842 10/842-245) WATER DISTR MAINS (POTABLE)-LF-(# LF & size, type of pipe)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(11) (843 11/843-315) FIRE HYDRANTS-EA-(#; size & type)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(12) (851 90/851-143) CURBS & GUTTERS-LF-(# LF; material; width & height)  
DESCRIPTION: (Is curb extruded or standard?)\_

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(13) (851 90/851-145) DRIVEWAY-SY-(SY; material used; thickness)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(14) (851 10/12/851-147) ROAD-SY & LF-(SY; material used; thickness; LF)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(14) (85210/11 /852-262) VEHICLE PARKING-SY-(SY; material used; thickness; #  
of  
bollards; # of wheel stops; # of regular parking spaces; # of handicap spaces)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(15) (852 20/852-289) SIDEWALKS-SY & LF-(# SF & LF; dimensions of each  
section & location; thickness; material used)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(16) (871 10/871-183) STORM DRAIN DISPOSAL-LF-(# LF of pipe; sizes & types of  
pipe; # of catch basins & manholes & sizes of each)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(17) (872 15/872-247) FENCE, SECURITY (ARMS)-LF-(# of LF; fence material; # &  
type of gate(s); # strands of barbed wire on top)  
DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(18) (87210/12/872-248) FENCE, INTERIOR-LF-(# of LF; fence material; # & kind  
of gate(s))

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(19) (890 70/890-187) UTILITY VAULT(4 or more transformers)- SF(# SF; dimensions of vault; # of xfmers)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(20) (135 10/135-583) TEL DUCT FACILITY-LF-(# of LF; size & type of conduit; type of wire)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

(21) (135 10/135-586) TEL POLE FACILITY-LF-(# LF & type of wire; # of poles)

DESCRIPTION:

\_\_\_\_\_  
\_\_\_\_\_

COST: \_\_\_\_\_

7. **INSTALLED EQUIPMENT:** Furnish an Equipment-In-Place List. Any price related to equipment should already be included in this checklist.

8. **SYSTEMS NOT PREVIOUSLY LISTED:** Attach a separate sheet and use the same format to describe the system(s). Example: CATV system, intercom system, or other utilities and surface construction not described on this checklist.

9. **ASBESTOS REMOVAL:** Furnish a description by building of the number of LF of asbestos removed, number of LF of reinsulation, number of SF of soil encapsulation, and number and size of tanks, etc., where asbestos was removed. Also, identify buildings by their numbers and use.

10. **MAINTENANCE/RENOVATIONS:** List by building number and describe all additions and deletions by quantity and the correct unit of measure. Furnish a cost per building.

**UTILITIES/SURFACE CONSTRUCTION** - Listed below are some additional items which may or may not apply to your contract. EACH item installed on site should be listed and priced separately even if not included on this checklist.

- (1) IRRIGATION SYSTEM-(LF of pipe; size & type of pipe; number and type of heads)
- (2) UNDERGROUND/ABOVEGROUND STORAGE TANKS-(GA, type of tank; material stored)
- (3) (833-354) DUMPSTER ENCLOSURE-(SF & dimensions)
- (4) (890-152) UNLOADING PAD-(SY; material)
- (5) SIGNAGE-(Dimensions; material)
- (6) (12580) CATHODIC PROTECTION-(MI; LF)
- (7) (87270) LIGHTNING PROTECTION-(LF)
- (8) (81290) POLE DUCT RISER-(LF, type of material)
- (9) RAMPS-(SF, material; CY if concrete-use code for sidewalk if concrete)
- (10) (89080/890-158) LOAD AND UNLOAD PLATFORM-(SF)
- (11) (83240/832-255) INDUSTRIAL WASTE MAIN-(LF)
- (12) WHEEL STOPS-(EA; size & material)
- (13) (81350) OUTDOOR INTEGRAL DISTR CTR-(KVA)
- (14) (45110) OUTDOOR STORAGE AREA-(SF)
- (15) (73055/730-275) BUS/WAIT SHELTER-(SF)
- (16) (690-432) FLAGPOLE-(EA; dimensions)
- (17) (93210) SITE IMPROVEMENT-(JOB)
- (18) (93220) LANDSCAPE PLANTING (Acre; EA; SF)
- (19) (93230) LANDSCAPE BERMS/MOUNDS-(SY)
- (20) (93410) CUT AND FILL-(CY)
- (21) (843-315) FIRE HYDRANTS-(EA; Type)
- (22) (14970) LOADING AND UNLOADING DOCKS AND RAMPS (not connected to a Bldg)-(SF)
- (23) BICYCLE RACK-(EA)
- (24) (85140/812-928) TRAFFIC SIGNALS-(EA)
- (25) (87210) FENCING OR WALLS-(LF)
- (26) (15432) RIPRAP-(LF & SY)
- (27) (75061) GRANDSTAND OR BLEACHERS-(EA; SE)
- (28) 87150/871-187) RETAINING WALLS-(LF; SY; material)

NOTE: 5 Digit Codes-Army; 6 Digit Codes-Air Force

## SECTION 01705

## EQUIPMENT-IN-PLACE LIST

## PART 1 GENERAL

## 1.1 SUBMITTALS

Data listed in PART 3 of this section shall be submitted in accordance with Section 01300 SUBMITTALS. Due dates shall be as indicated in applicable paragraphs and all submittals shall be completed before final payment will be made.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 Submittal

The final equipment-in-place list shall be completed and returned to the Contracting Officer within 30 calendar days of the final inspection. The Contracting Officer will review all final Equipment-In-Place Lists for accuracy and conformance to the requirements contained in DIVISION 1 GENERAL REQUIREMENTS. The lists shall be returned to the Contractor if corrections are necessary. The Contractor shall make all corrections and shall return the lists to the Contracting Officer within 7 calendar days of receipt.

## 3.2 EQUIPMENT-IN-PLACE LIST

Contractor shall submit for approval, at the completion of construction, a list of equipment-in-place. This list shall be updated and kept current throughout construction, and shall be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the Contractor prior to submission of each monthly pay estimate. A sample form showing minimum data required is provided at the end of this section. The EQUIPMENT-IN-PLACE LIST shall be comprised of all equipment falling under one or more of the following classifications:

- a. Each piece of equipment listed on the mechanical equipment schedules.
- b. Each electrical panel, switchboard, and MCC panel.
- c. Each transformer.
- d. Each piece of equipment or furniture designed to be movable.
- e. Each piece of equipment that contains a manufacturer's serial number on the name plate.
- f. All Government furnished, Contractor installed equipment per a. through e. (price data excluded)

## 3.3 PAYMENT

All costs incurred by the Contractor in the preparation and furnishing of Equipment-In-Place Lists shall be included in the contract price and no separate payment will be made for this work. Approval and acceptance of the

final Equipment-In Place Lists shall be accomplished before final payment is made to the Contractor.

**EQUIPMENT-IN-PLACE LIST**

**CONTRACT NO.:** \_\_\_\_\_

Specification Section: \_\_\_\_\_ Paragraph No. \_\_\_\_\_

**ITEM DESCRIPTION:** \_\_\_\_\_

Item Name: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Model Number: \_\_\_\_\_

Capacity: \_\_\_\_\_ Replacement Cost \_\_\_\_\_

**ITEM LOCATION:**

Building Number: \_\_\_\_\_ Room Number: \_\_\_\_\_

or Column Location: \_\_\_\_\_

**MANUFACTURER INFORMATION:**

Manufacturer Name: \_\_\_\_\_

Trade Name (if  
different from item name):  
\_\_\_\_\_

Manufacturer's Address: \_\_\_\_\_

\_\_\_\_\_

Telephone Number: \_\_\_\_\_

**WARRANTY PERIOD:** \_\_\_\_\_

CHECKED BY: \_\_\_\_\_

END OF SECTION



SECTION 02110  
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES (Not Applicable)

1.3 DEFINITIONS

1.3.1 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.

1.3.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 millimeters (mm) in diameter, and matted roots from the designated grubbing areas.

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 38 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 38 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. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

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 450 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

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations shall be disposed of outside the limits of Government-controlled land. Permission to dispose of such products on private property shall be in writing, and a copy of this permit shall be filed with the Contracting Officer. The Contractor shall be responsible for compliance with all Federal and State laws and regulations. Disposal of refuse and debris and any accidental loss or damage attendant thereto shall be the Contractor's responsibility.

END OF SECTION

## SECTION 02221

## EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS AND STRUCTURES

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 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 117 (1995) Materials Finer than 75- micrometer (um) Sieve in Mineral Aggregates by Washing
- ASTM C 136 (1996) Sieve Analysis of Fine and Coarse Aggregates
- ASTM D 422 (1963, R 1990) Particle-Size Analysis of Soils
- ASTM D 1556 (1990, R 1996) Density of Soil in Place by the Sand-Cone Method
- ASTM D 1557 (1991) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 4.5 kilogram (kg) Rammer and 450 millimeter (mm) Drop
- 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, Rock, and Soil-Aggregate Mixtures
- ASTM D 2217 (1985) Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
- ASTM D 2487 (1993) Standard Classification of Soils for Engineering Purposes (Unitified Soil Classification System)
- ASTM D 2922 (1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3017 (1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3740 (1996) Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- ASTM D 4318 (Rev. A, 1995) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

## 1.3 DEFINITIONS

### 1.3.1 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 1557 abbreviated hereinafter as percent 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: SUBMITTALS:

02221/3.9 Borrow Materials; GA.

02221/2.1.4 Select Granular Material for Footings, GA.

### 1.5 SUBSURFACE DATA

Subsurface soil exploration logs are shown on the drawings. This data represents the best subsurface information available; however, variations may exist in the subsurface between explorations locations.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Satisfactory Materials

Satisfactory materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Materials classified as SP-SM, GP-GM, and GM are also satisfactory provided that they contain a moisture content suitable for the intended use. Materials shall be free of trash, debris, roots or other organic matter, or stones larger than 75 mm in any dimension.

#### 2.1.2 Unsatisfactory Materials

Unsatisfactory materials include materials classified in ASTM D 2487 as PT, OH, OL, and any other materials not defined as satisfactory. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 75 mm.

#### 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. Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318 using ASTM D 2217, Procedure B. Determination of grain size for classification will be made in conformance with ASTM C 117, C 136, or D 422.

#### 2.1.4 Select Granular Material for Footings.

Select granular material shall consist of crushed, nonporous rock or crushed gravel meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing by weight</u>
75 mm	100

02221-2

4.75 mm	35-70
0.075 mm	0-15

### PART 3 EXECUTION

#### 3.1 CLEARING AND GRUBBING

The areas within lines 1.5 meters outside of each structure line shall be cleared and grubbed of trees, stumps, roots, brush and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be completely removed and the resulting depressions shall be filled with satisfactory material, placed and compacted in accordance with paragraph FILLING AND BACKFILLING. Materials removed shall be disposed of outside the limits of Government-controlled property. The Contractor shall be responsible for disposal of materials.

#### 3.2 TOPSOIL(NOT APPLICABLE)

#### 3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each structure and footing except as specified hereinafter, and shall include trenching for utility systems to a point 1.5 meters beyond the building line of each structure and all work incidental thereto. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. All soft or other unsatisfactory materials shall be removed from under buildings and structures with footings and replaced with satisfactory materials.

During excavation and construction operations foundation materials under structures shall not be disturbed by heavy construction equipment or other traffic that may cause pumping or rutting of the foundation materials below indicated finish grade. All material disturbed or softened by the Contractor's operations shall be removed, disposed, and replaced with satisfactory materials at the Contractor's expense. 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. In the event that it is necessary to remove unsatisfactory material to a depth greater than specified, the Contracting Officer shall be notified and an adjustment in the contract price will be considered in accordance with the contract. 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. 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 (Not Applicable).

#### 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.

#### 3.6 CLASSIFICATION OF EXCAVATION

Rock excavation shall consist of the removal and disposal of boulders 0.75 cubic meters or more in volume; solid rock; materials that cannot be removed without systematic drilling and blasting such as rock material in ledges or aggregate conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock; and concrete or masonry structures exceeding 0.75 cubic meters in volume, except sidewalks and paving. Hard and compact materials such as cemented gravel, glacial till, and relatively soft or disintegrated rock that can be removed without continuous and systematic drilling and blasting will not be considered as rock excavation. Rock excavation will not be considered as such because of intermittent drilling and blasting that is performed merely to increase production. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

#### 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 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.

#### 3.9 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained from sources outside the limits of Government-controlled land and in accordance with SECTION: EARTHWORK FOR ROADWAYS.

#### 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 excavated materials shall not be mixed with unsatisfactory materials. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of outside the limits of Government-controlled land and in accordance with SECTION: EARTHWORK FOR ROADWAYS. Unsatisfactory materials shall not cover available suitable materials.

### 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.

### 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 SOIL TREATMENT (Not Applicable)

### 3.14 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. 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 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 to avoid damage to coatings, or wrappings. 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
<u>Fill, embankment, and backfill</u>		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95

Under sidewalks and grassed areas	85	90
<u>Subgrade</u>		
Under structure 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. Compacted subgrades, fills, embankments, and backfills, that are distributed by the Contractor's operations or by adverse weather before acceptance by the Contracting Officer shall be scarified and compacted at the specified moisture content to the required density before the continuation of construction. Any field density test results indicating the density does not meet specifications shall be followed immediately with a second field density test and a corresponding laboratory quality control test at no additional cost to the Government. The location of the second field density test shall be in the same lift and within 3 meters of the first test and along the direction of travel of the compaction equipment. Should the second field density test also indicate insufficient density, filling or backfilling shall cease in the affected area until all deficiencies have been correction. Inadequate materials shall be removed, reworked, or replaced, compacted and tested at no additional cost to the Government. Recompaction over underground utilities and heating lines shall be by hand tampering. Compaction requirements in trenches shall conform to applicable portions of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

### 3.15 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. Testing facilities and personnel shall meet the requirements of ASTM D 3740 and SECTION: CONTRACTOR QUALITY CONTROL. Field in- place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. Moisture-density relations shall be determined in accordance with ASTM D 1557. The minimum number of tests, acceptable for each type of operation shall be in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

### 3.16 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.

### 3.17 GRADING

Areas within 1.5 meters outside of each 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.

### 3.18 SPREADING TOPSOIL (NOT APPLICABLE)

### 3.19 PROTECTION

Settlement or washing that occurs in graded 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 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 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 117  | (1995) Materials Finer than 75-micrometer (um) (No. 200) Sieve in Mineral Aggregates by Washing                        |
| ASTM C 136  | (1996) Sieve Analysis of Fine and Coarse Aggregates  |
| ASTM D 422  | (1963, R 1990) Particle-Size Analysis of Soils   |
| ASTM D 1556 | (1990, R 1996) Density of Soil in Place by the Sand-Cone Method  |
| ASTM D 1557 | (1991) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 4.54 kilogram (kg )Rammer and 457-mm Drop |
| 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, Rock, and Soil-Aggregate Mixtures                 |
| ASTM D 2217 | (1985) Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants                  |
| ASTM D 2487 | (1993) Standard Classification of Soils for Engineering Purposes (Unitified 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 (1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3740 (1996) Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- ASTM D 4318 (Rev. A, 1995) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- U.S. Army Corps of Engineers Manual:
- EM 385-1-1 Safety and Health Requirements

### 1.3 DEFINITIONS

#### 1.3.1 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 DESCRIPTIONS:

#### Reports

Field Density Tests; GA.

Testing of Backfill Materials; GA.

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 GW, GP, SP, and SW. Materials classified as SM, SP-SM, GP-GM, or GM are also satisfactory provided that they contain moisture content suitable for the intended use.

#### 2.1.2 Unsatisfactory Materials

Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 75 mm, and materials classified in ASTM D 2487, as PT, OH, and OL. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

#### 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 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. Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318 using ASTM D 2217, Procedure B. Determination of grain size for classification will be made in conformance with ASTM C 117, ASTM C 136, or ASTM D 422.

#### 2.1.4 Rock

Rock shall consist of boulders 0.75 cubic meters or more in volume; solid rock; materials that cannot be removed without systematic drilling and blasting such as rock material in ledges or aggregate conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock; and below ground concrete or masonry structures exceeding 0.75 cubic meters in volume, except sidewalks and paving. Hard and compact materials such as cemented gravel, glacial till, and relatively soft or disintegrated rock that can be removed without continuous and systematic drilling and blasting will not be considered as rock. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer.

#### 2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 75 mm 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 mm, 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 or satisfactory materials free from rocks 50 mm 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 25 mm in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

### 2.1.9 Plastic Marking Tape

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 150 mm wide with minimum thickness of 0.1 mm. Tape shall have a minimum strength of 12 megapascals (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 900 mm 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

### 2.1.10 BORROW MATERIAL

Borrow material shall be selected to meet requirements and conditions of the particular fill for which it is to be used. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

#### 2.1.10.1 Selection

Borrow materials shall be obtained from sources outside the limits of Government-controlled land. Borrow materials shall be subject to approval. The source of borrow material shall be the Contractor's responsibility. The Contractor shall obtain from the owners the right to procure material, shall pay all royalties and other charges involved, and shall bear all the expense of developing the sources, including rights-of-way for hauling.

#### 2.1.10.2 Borrow Pits

Except as otherwise permitted, borrow pits shall be excavated to afford adequate drainage. The Contractor shall be responsible for

maintaining the borrow sites subject to the owner/operator requirements and all applicable laws and regulations. Maintenance is to include access road maintenance and dust control by watering.

### PART 3 EXECUTION

#### 3.1 EXCAVATION

Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. 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 and shall be disposed of outside the limits of Government-controlled land. The Contractor shall be responsible for disposal of materials. Any excess satisfactory excavated materials shall not be mixed with unsatisfactory materials. Unsatisfactory materials shall not cover available suitable materials. 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 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. 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 excavated to a stable angle of repose as required to properly complete the work. Trench excavations shall adhere to requirements prescribed in EM 385-1-1, Safety and Health Requirements Manual. 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 36 inches 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 mm 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 overdepth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 100 mm below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING.

#### 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. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of 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.

#### 3.1.1.6 Stockpiles

Stockpiles of satisfactory 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

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. The first 150 mm of backfill material directly above PVC or copper pipes shall not be compacted. The backfill shall be brought up evenly on both sides of the pipe for the full length. Care shall be taken to ensure thorough compaction of the full under the haunch of the pipe. Material required for backfills in excess of that produced by excavation shall be obtained from borrow areas.

#### 3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 600 mm above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test. The trench shall not be backfilled until all specified tests are performed.

##### 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 of the type and thickness shown. Bedding shall be clean, sand-gravel mixture free from organic matter and conforming to the following gradation when tested in accordance with ASTM D 422.

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing</u>
25 mm	100
4.75 mm	25-80
0.075 mm	0-10

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. Backfill material in this portion of the trench shall consist of satisfactory material at a moisture content that will facilitate

compaction, free from stones of such size as recommended by the pipe manufacturer, or larger than 50 mm in any dimension, whichever is smaller, except that where the pipe is coated or wrapped for protection against corrosion, the backfill material shall be free of stones larger than 25 mm in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

#### 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:

##### 3.2.1.4.1 Roadways

Backfill shall be placed up to the elevation at which the requirements in SECTION: EARTHWORK FOR ROADWAYS control. Water flooding or jetting methods of compaction will not be permitted.

##### 3.2.1.4.2 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 3 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 Gas Distribution (Not Applicable)

#### 3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 1066 mm from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

#### 3.3.3 Heat Distribution System (Not Applicable)

### 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: ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

### 3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 450 mm 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. Number of tests shall be in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

### 3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory. Approval of testing facilities and personnel shall be based on compliance with ASTM D 3740 and in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

### 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 laboratory tests for moisture-density relations of soils in accordance with ASTM D 1557. A mechanical tamper may be used, provided the results are correlated with those obtained by the referenced hand tamper or ASTM D 1557. Field in-place density shall be determined in accordance with ASTM D 1556 or D 2167. 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.

### 3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. 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 at least 600 mm above the top of the pipe or finished grade whichever is shallower, 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

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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 judgment 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 02225

## EARTHWORK FOR ROADWAYS

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 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	(1984a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1140	(1954; R 1990) Amount of Material in Soils Finer than the No. 200 Sieve
ASTM D 1556	(1990) Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1978; R 1991) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18 inch Drop.
ASTM D 2167	(1984; R 1990) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2217	Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Particles
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
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 3740	Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

## 1.3 DEFINITIONS

## 1.3.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, SP, and SW. Materials classified as SP-SM, SM, GP-GM and GM are also satisfactory provided they contain moisture contents suitable for the intended use and are free of organic matter. The maximum particle size shall be 75 mm.

#### 1.3.2 Unsatisfactory Materials

Unsatisfactory materials shall comprise any materials classified by ASTM D 2487 as Pt, OH, OL, and any materials containing organic matter or having moisture contents unsuitable for the intended use.

#### 1.3.3 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 C 136, ASTM D 422, ASTM D 1140, D 2217 Procedure B, and ASTM D 4318,.

#### 1.3.4 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 1557. This will be abbreviated below as a percent 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 DESCRIPTIONS:

#### Statements

Earthwork; FIO.

Procedure and location for disposal of unused satisfactory material and unsatisfactory materials. Proposed source of borrow material.

#### Reports

Testing; GA.

Within 24 hours of conclusion of physical tests, copies of test results, including calibration curves and results of calibration tests. Testing results of borrow materials.

#### Certificates

Testing; GA.

Qualifications of the commercial testing laboratory.

#### Records

Earthwork; FIO.

Advance notice on the opening of excavation. Advance notice on shoulder construction for rigid pavements.

#### 1.5 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

#### 1.6 BLASTING

Blasting will not be permitted.

#### 1.7 UTILIZATION OF EXCAVATED MATERIALS

All unsatisfactory materials removed from excavations shall be disposed of outside the limits of Government-controlled land. The Contractor shall be responsible for disposal of materials. 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 outside the limits of Government-controlled land as directed. No excavated material shall be disposed of in such a manner as 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 (Not Applicable)

##### 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 herein. 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 up to a maximum depth of 750 mm measured from the top of the subgrade and replaced with satisfactory materials as directed by the Contracting Officer. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of outside the limits of Government-controlled land. Unsatisfactory excavated material shall be disposed of outside the limits of Government-controlled land. Disposal of materials shall be the responsibility of the Contractor. 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 obtained from sources outside the limits of Government-controlled land, subject to approval.

##### 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. Care shall be taken not to excavate ditches and gutters 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 at no additional cost to the Government. Material excavated

shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain all 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 accurately 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. 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.

### 3.3 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 outside the limits of Government-controlled land, subject to approval. The Contractor shall obtain from the owners the right to procure material, pay all royalties and other charges involved, and bear all expense of developing the sources, including rights-of-way for hauling. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation and shall be performed by the Contractor at no additional cost to the Government.

### 3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

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

When so provided and where indicated, work under contract 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 as specified in such a manner as to prevent wedging action or eccentric loading upon or against any structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS.

### 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; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted as specified. 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 mm 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 as specified

## 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 up to a maximum depth of 750 mm measured from the top of the subgrade and replaced with satisfactory excavated material or other approved material as directed. Low areas resulting from removal of unsatisfactory material 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.

### 3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot roller, pneumatic-tired rollers, smooth-drum vibratory rollers or other approved equipment well suited to the soil being compacted. Generally, sheepsfoot rollers are best suited for compacting cohesive material while smooth-drum vibratory rollers are best suited for compacting cohesionless materials. Each layer shall be compacted to not less than the percentage of maximum dry density specified be below:

	Percent Laboratory maximum density	
	Cohesive Material	Cohesionless Material
<u>Fill, embankment, and backfill</u>		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
<u>Subgrade</u>		
Under building slabs, steps, and paved areas, top 300 mm	90	95
Under sidewalks, top 150 mm	85	90

Compacted subgrades, fills, embankments, and backfills that are disturbed by the Contractor's operations or by adverse weather before acceptance by the Contracting Officer shall scarified and compacted at the specified moisture content to the required density before the continuation of construction. Any field density test result indicating the density does not meet specifications shall be followed immediately with a second field density test and a corresponding laboratory quality control test at no additional cost to the Government. The location of the second field density test shall be in the same lift and within 3 meters of first test and along the direction of travel

of the compaction equipment. Should the second field density test also indicate insufficient density, filling or backfilling shall cease in the affected area until all deficiencies have been corrected. Inadequate materials shall be removed, reworked, or replaced, compacted and tested at no additional cost to the Government.

### 3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow materials or as otherwise shown or specified herein. 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. 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 all 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. 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 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. Moisture-density relations shall be determined in accordance with ASTM D 1557. The minimum number of tests, acceptable for each type of operation shall be in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

#### 3.12.1 Testing Facilities

Testing shall be performed by an approved commercial testing laboratory. Testing facilities and personnel shall meet requirements of ASTM D 3740 and shall be in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

3.12.2 Optimum Moisture and Laboratory Maximum Density: Moisture-density relations shall be determined in accordance with ASTM D 1557.

#### 3.12.3 In-Place Densities

Field in-place density shall be determined in accordance with ASTM D 1556 or D 2167. Within 24 hours of conclusion of physical tests, 2 copies of test results, shall be furnished to 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 recompact to meet specification requirements, at no additional expense to the Government. Tests on recompact areas shall be performed to determine conformance with specification requirements.

Inspections and test results shall be certified by a registered professional 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 minimum acceptable number of tests, acceptable for each type of operation shall be in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

### 3.13 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as 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 subbase, base or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase course, base course or pavement shall be laid until the subgrade has been checked and approved, and in no case shall base or pavement be placed on a muddy, spongy, or frozen subgrade.

END OF SECTION



## SECTION 02234

## SUBBASE 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 (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 (1989) 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 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 4318 (1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM E 11 (1995) Wire-Cloth Sieves for Testing Purposes

## 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 or AASHTO T 180, Method D. ASTM D 1557 shall be used for maximum density determinations if the anticipated material gradation will contain less than 30% retained on the 19 mm (3/4 inch)

sieve. AASHTO T 180, Method D shall be used for the maximum density determinations if the anticipated material gradation will contain more than 30% retained on the 19 mm (3/4 inch) sieve. This will be abbreviated herein after as 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:

##### Data

Equipment; FIO.

List of proposed equipment to be used in performance of construction work, including descriptive data.

##### Reports

Sampling and Testing; GA.

Copies of initial and in-place test results.

##### Records

Waybills and Delivery Tickets; FIO.

Copies of waybills and delivery tickets during the progress of the work. Certified waybills and delivery tickets for all aggregates actually used.

#### 1.5 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 testing facilities of his own, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities shall be at the expense of the Government and any subsequent inspections required because of failure of the first inspection will 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.

##### 1.5.1 Sampling

Sampling for laboratory testing shall be 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. 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 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.

### 1.5.2.4 Wear Test

Wear tests shall be made in conformance with ASTM C 131.

### 1.5.2.5 Weight Per Cubic Meter (Foot) of Slag

Weight per cubic meter (foot) of slag shall be determined in accordance with ASTM C 29.

### 1.5.2.6 Moisture-Density Determinations

The maximum density and optimum moisture shall be determined in accordance with ASTM D 1557 or AASHTO T 180, Method D.

## 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
- c. Wear
- d. Weight per cubic meter foot of Slag

### 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 1000 square meters yards 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 60 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 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

Subbase courses shall be constructed when the atmospheric temperature is above 2 degrees C. (35 degrees F.) When the temperature falls below 2 degrees C, (35 degrees F,) the Contractor shall protect all areas of completed subbase course by approved methods against detrimental effects of freezing. Areas of completed subbase course 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

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 (No. 4) 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 meters (65 pcf). Aggregates shall have a maximum size of 75 millimeters (3 inches) and shall be within the limits specified as follows:

Maximum Allowable Percentage by Weight  
Passing Square-Mesh Sieve

<u>Sieve Designation</u>	<u>Percentage</u>
2 mm	50
0.075 mm	15

Maximum Allowable Percentage by Weight  
Passing Square-Mesh Sieve

<u>Sieve Designation</u>	<u>Percentage</u>
No. 10	50
No. 200	15

The portion of any blended component and of the completed course passing the 0.425 mm (No. 40 sieve) shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The subbase course shall be a nonfrost-susceptible material. Particles having a diameter of less than 0.02 mm shall not exceed 3 percent by weight of the total aggregate, as determined in accordance with ASTM D 422, tested in the completed layer.

### 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 shall be cleaned of all foreign substances. Subgrade shall conform to the requirements of 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 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 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 subbase course. Stabilization shall be accomplished by mixing subbase-course material into the underlying course, and compacting by approved methods. The stabilized material will 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 site of the work.

### 3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed in such a manner as to obtain uniformity of the subbase material and 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 subbase course shall be as indicated. When a compacted layer of 150 mm (6 inches) is specified, the material may be placed in a single layer; when a compacted thickness of more than 150 mm (6 inches) is required, no layer shall exceed 150 mm (6 inches) nor be less than 75 mm (3 inches) 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 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. 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 95 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.

### 3.9 EDGES OF SUBBASE COURSE

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 (1 foot) 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 9.5 mm (3/8 inch) when tested with a 3.05 mm (10 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 measurement

shall be made by test holes, at least 75 mm (3 inches) in diameter through the course. The completed subbase course shall not be more than 13 mm (1/2 inch) deficient in thickness nor more than 13 mm (1/2 inch) 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 of the subbase course is 13 mm (1/2 inch) or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 13 mm (1/2 inch). The average job thickness shall be the average of the job measurements as specified above but within 6 mm (1/4 inch) of the thickness shown.

### 3.12 MAINTENANCE

The subbase course shall be maintained in a satisfactory condition until accepted.

END OF SECTION



## SECTION 02241

## 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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29	(1991a) Unit Weight and Voids in Aggregate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Course Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) 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 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
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

## 1.3 DEFINITIONS

## 1.3.1 Aggregate Base

Aggregate base as used herein is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

### 1.3.2 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 1557 abbreviated hereinafter as percent laboratory maximum density.

## 1.4 GENERAL

The work specified herein consists of the construction of an aggregate base course. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans. Sources of all materials shall be selected well in advance of the time that materials will be required in the work.

## 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:

### Data

Plant, Equipment, Machines, and Tools; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data.

### Reports

Sampling and Testing; GA.  
Field Density; GA.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

### Records

Waybills and Delivery Tickets; FIO.  
Coarse Aggregate; GA.

Copies of waybills and delivery tickets during the progress of the work. Certified waybills and delivery tickets for all materials actually used. A notification stating which type of coarse aggregate is to be used.

## 1.7 WEATHER LIMITATIONS

Base shall not be constructed when the atmospheric temperature is less than 2 degrees C. (35 degrees F.) Base shall not be constructed on subgrades that are frozen or contain frost. If the temperature falls below 2 degrees C, (35 degrees F,) completed areas shall be protected against any detrimental effects of freezing.

## 1.8 PLANT, EQUIPMENT, MACHINES, AND TOOLS

### 1.8.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in satisfactory working condition at all times. Other compacting equipment may be used in lieu of that specified, where it can be demonstrated that the results are equivalent. The equipment shall be adequate and have the capability of producing the results specified.

#### 1.8.2 Steel-Wheeled Rollers

Steel-wheeled rollers shall be the self-propelled type weighing not less than 9 metric tons, (10 tons,) with a minimum weight of 135 kilograms per millimeter (300 pounds per inch) width of rear wheel. Wheels of the rollers shall be equipped with adjustable scrapers. The use of vibratory rollers is optional.

#### 1.8.3 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall have four or more tires, each loaded to a minimum of 13,600 kilograms (30,000 pounds) and inflated to a minimum pressure of 1035 kPa. (150 psi.) The loading shall be equally distributed to all wheels, and the tires shall be uniformly inflated. Towing equipment shall also be pneumatic-tired.

#### 1.8.4 Mechanical Spreader

Mechanical spreader shall be self-propelled or attached to a propelling unit capable of moving the spreader and material truck. The device shall be steerable and shall have variable speeds forward and reverse. The spreader and propelling unit shall be carried on tracks, rubber tires, or drum-type steel rollers that will not disturb the underlying material. The spreader shall contain a hopper, an adjustable screed, and outboard bumper rolls and be designed to have a uniform, steady flow of material from the hopper. The spreader shall be capable of laying material without segregation across the full width of the lane to a uniform thickness and to a uniform loose density so that when compacted, the layer or layers shall conform to thickness and grade requirements indicated. The Contracting Officer may require a demonstration of the spreader prior to approving use in performance of the work.

#### 1.8.5 Sprinkling Equipment

Sprinkling equipment shall consist of tank trucks, pressure distributors, or other approved equipment designed to apply controlled quantities of water uniformly over variable widths of surface.

#### 1.8.6 Tampers

Tampers shall be of an approved mechanical type, operated by either pneumatic pressure or internal combustion, and shall have sufficient weight and striking power to produce the compaction required.

#### 1.8.7 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 3.05 meter (10 foot) straightedge for each bituminous paver, for use in the testing of the finished surface. 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 ensure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

### 1.9 STOCKPILING MATERIALS

Materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at locations designated. Before stockpiling of material, storage sites shall be cleared, and sloped to drain. Materials obtained from different sources shall be stockpiled separately.

#### 1.10 SAMPLING AND TESTING

##### 1.10.1 General Requirements

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and at the locations and times directed to insure that materials and compaction meet specified requirements. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of tests.

##### 1.10.2 Test Results

Results shall verify that materials comply with this specification. When a material source is changed, the new material will be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or modified as directed by the Contracting Officer.

##### 1.10.3 Sampling

Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75.

##### 1.10.4 Sieve Analysis

Before starting work, at least one sample of material shall be tested in accordance with ASTM C 136 and ASTM D 422 on sieves conforming to ASTM E 11. After the initial test, a minimum of one analysis shall be performed for each 1000 metric tons (1000 tons) of material placed, with a minimum of three analyses for each day's run until the course is completed.

##### 1.10.5 Liquid Limit and Plasticity Index

One liquid limit and plasticity index shall be performed for each sieve analysis. Liquid limit and plasticity index shall be in accordance with ASTM D 4318.

##### 1.10.6 Laboratory Density

Tests shall provide a moisture-density relationship for the aggregate. Tests shall be conducted in accordance with ASTM D 1557.

##### 1.10.7 Weight Per Cubic Meter (Foot) of Slag

Weight per cubic meter (foot) of slag shall be determined in accordance with ASTM C 29.

##### 1.10.8 Wear Tests

Wear tests shall be performed in accordance with ASTM C 131. One test shall be run per 2000 square meter (yards) of completed base course. A minimum of one test per aggregate source shall be run.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Aggregates

Aggregates shall consist of crushed stone or slag, crushed gravel, angular sand, or other approved material. Aggregates shall be durable and sound, free from lumps of clay, organic matter, objectionable coatings, and other foreign material. Material retained on a 4.75 mm (No. 4) sieve shall be known as coarse aggregate and that passing the 4.75 mm (No. 4) sieve shall be known as binder material.

##### 2.1.1.1 Coarse Aggregate

Only one type of coarse aggregate shall be used on the project. Coarse aggregates, consisting of angular fragments of uniform density and quality, shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3, and an elongated particle is one having a ratio of length to width greater than 3.

a. Crushed Gravel: Crushed gravel shall be manufactured from gravel particles 50 percent of which by weight are retained on the maximum size gradation sieve specified.

b. Crushed Stone: Crushed stone retained on each sieve specified shall contain at least 50 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 piece. When two fractures are adjacent, the angle between the planes of the fractures must be at least 30 degrees to count as two fractured faces.

##### 2.1.1.2 Slag

Slag shall be an air-cooled blast-furnace product having a dry unit weight of not less than 1045 kg/cubic meter (65 pcf).

##### 2.1.2 Binder Material

Binder material shall consist of screenings, angular sand, or other finely divided mineral matter processed or naturally combined with the coarse aggregate. Liquid-limit and plasticity-index requirements shall apply to any component that is blended to meet the required gradation and shall also apply to the completed course. The portion of any component or of the completed course passing the 0.425 mm (No. 40) sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

##### 2.1.3 Gradation

Requirements for gradation specified shall apply to the completed base course. The aggregates shall have a 37.5 millimeter (1-1/2 inch) maximum size and shall be continuously graded within the following limits:

<u>Sieve</u> <u>Designation</u>	<u>Percentage by Weight Passing</u> <u>Square-mesh Sieve (a) (b)</u>	
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	<u>No. 1</u>	<u>No. 2</u>
50 mm	---	---
37.5 mm	100	---
25 mm	60-100	100
12.5 mm	30-65	40-70
4.75 mm	20-50	20-50
2 mm	15-40	15-40
0.425 mm	5-25	5-25
0.075 mm	0-5	0-5

<u>Sieve Designation</u>	<u>Percentage by Weight Passing Square-mesh Sieve (a) (b)</u>	
	<u>No. 1</u>	<u>No. 2</u>
2 inch	---	---
1-1/2 inch	100	---
1 inch	60-100	100
1/2 inch	30-65	40-70
No. 4	20-50	20-50
No. 10	15-40	15-40
No. 40	5-25	5-25
No. 200	0-5	0-5

(a) Particles having diameters less than 0.02 millimeter shall not be in excess of 3 percent by weight of the total sample tested.

(b) The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction in accordance with ASTM C 127 and ASTM C 128 when aggregates of varying specific gravities are used.

### PART 3 EXECUTION

#### 3.1 GENERAL REQUIREMENTS

When the base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

#### 3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from off-site sources.

#### 3.3 PREPARATION OF UNDERLYING COURSE

##### 3.3.1 General Requirements

Before constructing aggregate base course, the previously constructed underlying course shall be cleaned of foreign substances. Surface of underlying course shall meet the specified compaction and surface tolerances. Subgrade shall conform to Section 02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS. Subbase course shall conform to Section 02234 SUBBASE COURSE. Ruts or soft, yielding spots that may appear in the underlying course, areas

having inadequate compaction, and deviations of the surface from requirements specified shall be corrected. For cohesionless underlying materials containing sands, sand gravels, or any other cohesionless material in harmful quantities, the surface shall be mechanically stabilized with aggregate prior to placement of the aggregate course. Stabilization may be accomplished by mixing base course material into the underlying course and compacting by approved methods. Properly compacted material will be considered as part of the underlying course and shall meet all requirements for the underlying course. Finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until base course is placed.

### 3.3.2 Grade Control

Underlying material shall be excavated to sufficient depth for the required base course thickness so that the finished base course with the subsequent surface course will meet the fixed grade. Finished and completed area shall conform to the lines, grades, cross section, and dimensions indicated.

## 3.4 INSTALLATION

### 3.4.1 Mixing and Placing

Materials shall be mixed by the stationary plant, traveling plant, or road mix method and placed in such a manner as to obtain uniformity of the aggregate base course material and at a uniform optimum water content for compaction. The Contractor shall make such adjustments in mixing or placing procedures or in equipment to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to ensure a satisfactory base course.

### 3.4.2 Edges of Base Course

Approved material shall be placed along edges of aggregate base course in such quantities as will compact to thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 300 mm (1 foot) width of the shoulder to be rolled and compacted simultaneously with rolling and compacting of each layer of base course.

### 3.4.3 Compaction

Each layer of aggregate base course, including shoulders, shall be compacted. Water content shall be maintained at optimum. Density of compacted mixture shall be at least 100 percent of laboratory maximum density. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. Areas inaccessible to the rollers shall be compacted with mechanical tampers, and shall be shaped and finished by hand methods.

### 3.4.4 Layer Thickness

Compacted thickness of the aggregate course shall be as indicated. No layer shall be in excess of 200 mm (8 inches) nor less than 75 mm (3 inches) in compacted thickness.

### 3.4.6 Finishing

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, recompacted, or replaced as directed.

#### 3.4.6.1 Smoothness

Surface of each layer shall show no deviations in excess of 9.5 mm (3/8 inch) (3/8 inch) when tested with the 3.05 meter (10 foot) straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed.

#### 3.4.6.2 Thickness Control

Compacted thickness of the base course shall be within 7 mm (1/4 inch) of the thickness indicated. Where the measured thickness is more than 7 mm (1/4 inch) deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 7 mm (1/4 inch) thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 7 mm (1/4 inch) of the thickness indicated.

### 3.5 FIELD QUALITY CONTROL

#### 3.5.1 Field Density

Field in-place density shall be determined 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. At least one field density test shall be performed for each 250 square meters (yards) of each layer of base material.

#### 3.5.2 Smoothness

Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 3.05 meter (10 foot) straightedge. Measurements shall also be taken perpendicular to the road centerline at 15 meter (50 foot) intervals.

#### 3.5.3 Thickness

Thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square meters (yards) of base course. Measurements shall be made in 75 mm (3 inch) diameter test holes penetrating the base course.

### 3.6 TRAFFIC

Completed portions of the area may be opened to traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

### 3.7 MAINTENANCE

The aggregate base course shall be maintained in a satisfactory condition until accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact.

### 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Removed in-place materials that are unsuitable for the base course material that is removed for the required correction of defective areas, and waste material and debris shall be disposed of become the property of the Contractor and removed off-site.

END OF SECTION

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## SECTION 02510

## 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 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 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

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA B300 (1992) Hypochlorites
- AWWA B301 (1992) Liquid Chlorine
- AWWA C500 (1993) Gate Valves for Water and Sewerage Systems
- AWWA C502 (1985) Dry-Barrel Fire Hydrants

AWWA C700 (1990; C700a) Cold-Water Meters - Displacement Type, Bronze Main Case

AWWA C900 (1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

AWWA M23 (1980) Manual: PVC Pipe - Design and Installation

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 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

NFPA 1961 (1992) Fire Hose

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 galvanized steel, 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 or steel, 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 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.

### 1.2.4 Plastic Pipe

All plastic piping system components (PVC) intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

### 1.2.5 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

## 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 01330 SUBMITTAL PROCEDURES:

#### Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

#### Statements

Waste Water Disposal Method; FIO.

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.

## 1.4 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.

#### 1.4.1 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 Plastic Pipe

###### 2.1.1.1 Polyethylene Plastic (PE)

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

###### 2.1.1.1 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:

<u>SDR</u>	<u>Maximum Working Pressure MPa</u>	<u>Minimum Hydrostatic Pressure MPa</u>
26	0.689	0.917
21	0.827	1.103
17	1.034	1.379

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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.

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 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 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.

## 2.7 MISCELLANEOUS ITEMS

### 2.7.1 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.

### 2.7.2 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.

### 2.7.3 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.

### 2.7.4 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 .

### 2.7.5 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.

### 2.7.6 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

### 2.7.7 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.

#### 2.7.7.1 Displacement Type

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in cubic feet. 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. Meters shall comply with the accuracy and capacity requirements of AWWA C700.

#### 2.7.8 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 use concrete covers with cast iron meter reader lids. Plastic boxes and lids shall not 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.

## 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 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 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.

#### 3.1.4 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 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.

##### 3.1.4.2 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.

#### 3.1.4.3 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.

#### 3.1.4.4 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 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.

##### 3.1.5.2 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 and Smaller

Service lines 50 mm 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

Pipe Size mm	Outlets w/Service Clamps, mm
	<u>Single &amp; Double Strap</u>
80	25
100	25
150	40
200	50
250	50
300	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 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

##### 3.1.7.1 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.

#### 3.1.7.2 Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

#### 3.1.7.3 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.

#### 3.1.7.4 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.

#### 3.1.8 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

#### 3.1.9 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 either thrust blocks or, for ductile-iron pipes, restrained joints.

##### 3.1.9.1 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 02221 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 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:

$$L = 0.0001351ND(P \text{ raised to } 1/2 \text{ power})$$

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 as specified herein. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner.

Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case will the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, the Contracting Officer will take samples of water in proper sterilized containers for bacterial examination.

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

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## SECTION 02530

## SANITARY 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 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 478	(1994) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1994) Precast Reinforced Concrete Manhole Sections (Metric)
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 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 F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 794	(1995a) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	(1993a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105	(1988) Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
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## 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 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. 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 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:

## Certificates

Portland Cement; FIO.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

## PART 2 PRODUCTS

### 2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

#### 2.1.1 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.

##### 2.1.1.1 ABS Pipe

ASTM D 2751.

##### 2.1.1.2 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.

### 2.2 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 Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

##### 2.2.1.1 ABS Pipe

ASTM D 2751

##### 2.2.1.2 PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. BPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

### 2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

#### 2.3.1 Plastic Pipe

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

### 2.3.1.1 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.

## 2.4 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, ductile iron or reinforced concrete. 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. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478 or ASTM C 478M. 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

## 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. 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 Structures

Where sewer pipe is to be installed within 1 m such as a retaining wall, control tower footing, water tank footing, 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 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.

#### 3.1.2.2 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.

#### 3.1.2.3 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02221 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.

#### 3.1.2.4 Joints

Joints between different pipe materials shall be made as specified, using approved jointing materials.

#### 3.1.2.5 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 concrete 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 600 liters per 10 mm diameter per kilometer. 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 supported on a concrete cradle, or 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 or supported on a concrete cradle 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 02540

## DRAINFIELDS

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 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 127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 136	(1996) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987) Sampling Aggregates
ASTM D 2751	(1996; Rev. A) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1997) Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM D 4632	(1991) Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1987) Determining Apparent Opening Size of a Geotextile
ASTM E 11	(1987) Wire-Cloth Sieves for Testing Purposes

## 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 01330; SUBMITTAL PROCEDURES:

Samples GA.

Samples of filter fabric, pipe, and pipe fittings shall be submitted and approved before starting the work.

Test Reports GA.

Source of drainfield aggregate shall be selected well in advance of the time that materials will be required in the work. Test results from samples shall be submitted for approval not less than 30 days before material is required for the work.

Certificates of Compliance FIO.

Certifications from the manufacturers attesting that materials meet specification requirements shall be submitted. Certificates are required for

drain pipe, drain tile and filter fabric. Results of laboratory tests of drainfield aggregate gradation shall be submitted for control purposes.

#### 1.4 DELIVER, STORAGE, AND HANDLING

##### 1.4.1 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 be such that the fabric is protected 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.

##### 1.4.2 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.

#### 1.5 SAMPLING AND TESTING

##### 1.5.1 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. Tests shall be performed in sufficient number to insure that materials meet specified requirements. Copies of test results shall be furnished to the Contracting Officer. Samples for material gradation shall be taken in conformance with ASTM D 75. Samples required during production shall be the basis for approval of specified lots from the standpoint of all requirements except gradation. When deemed necessary, the sampling of materials will be observed by the Contracting Officer; however, samples to be used as the basis for final approval in determining gradation shall always be obtained under observation of the Contracting Officer.

##### 1.5.2 Tests

Sieve analyses shall be made in conformance with ASTM C 127 and C 136. Sieves shall conform to ASTM E 11.

##### 1.5.3 Approval of Material

The source of the material to be used shall be selected well in advance of the time materials will be required in the work. Tentative approval of the source will be based on an inspection by the Contracting Officer. Tentative approval of the material will be based on results of samples from test pits, borings, or other excavations, or from samples of current production in the case of an existing producer. Final approval of material from the standpoint of gradation and density shall be based on tests made on the completed in-place material layer. The completed layer is defined as a layer that is ready for the next layer.

#### 1.6 STOCKPILING MATERIAL

Prior to stockpiling of material, the storage site shall be cleared, drained, and leveled. material shall be stockpiled in the manner and at the locations

designated by the Contracting Officer. Different borrow materials shall be stockpiled separately so as to prevent segregation.

## PART 2 PRODUCTS

### 2.1 PIPE FOR DRAINFIELD

Pipe for drainfield shall be of the types and sizes indicated.

#### 2.1.1 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

##### 2.1.1.1 Acrylonitrile-Butadiene-Styrene (ABS) Piping

Acrylonitrile-butadiene-styrene (ABS) piping and fittings shall conform to ASTM D 2751, with maximum SDR of 35.

##### 2.1.1.2 Polyvinyl Chloride (PVC) Pipe and Fittings

Polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D 3034, Type PS 46.

##### 2.1.1.3 Pipe Perforations

Orifice size and spacing shall be as shown. Circular holes shall be cleanly cut and arranged in rows parallel to the longitudinal axis of the pipe. 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.

### 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 (EOS) no finer than the US Standard Sieve No. 100 and no coarser than the US Standard Sieve No. 70 in accordance with ASTM D 4751. EOS is defined as the number of the US Standard sieve having openings closest in size to the filter fabric openings. The fabric shall contain stabilizers and/or inhibitors added to the base material to make it resistant to deterioration due to ultraviolet and heat exposure. The fabric shall have a minimum physical strength of 36.78 newtons per mm (210 pounds per inch) in any direction when tested in accordance with ASTM D 4632 using the grab test method with 1 square inch jaws and a constant rate of travel of 300 mm per minute. Elongation at failure shall be 30 percent minimum in any principal direction. 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 salvaged or otherwise finished to prevent the outer material from pulling away from the fabric. The fabric shall be woven into a width such that it may be installed with a maximum of two overlapping or three field sewn longitudinal seams.

### 2.3 DRAINFIELD AGGREGATE AND SATISFACTORY BACKFILL MATERIAL

#### 2.3.1 Drainfield Aggregate

Drainfield aggregate shall be washed gravel, crushed stone, crushed stone screenings, or slag composed of hard, tough, durable particles free from adherent coatings. Material shall not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles and shall be evenly

graded between the limits specified in TABLE I. Gradation curves will exhibit no abrupt changes in slope denoting skip or gap grading. Materials shall be clean and free from soil and foreign materials. Materials found to be dirty or otherwise contaminated shall be removed and replaced with material meeting the specific requirements, at no additional cost to the Government.

TABLE I. FILTER GRADATION

Passing 65 mm Sieve (square opening)	100 Percent by Weight
Passing 20 mm Sieve	0-2 Percent by Weight

### 2.3.2 Satisfactory Backfill

Satisfactory backfill material shall consist of excavated material conforming to the requirements for satisfactory material specified in SECTION: GRADING (EARTHWORK).

## PART 3 EXECUTION

### 3.1 EQUIPMENT

All plant, equipment, tools, and machines used in the performance of the work shall be approved prior to commencement of work and shall be maintained in satisfactory working condition at all times.

#### 3.1.1 Hauling Equipment

Hauling equipment shall consist of pneumatic-tired vehicles having dump bodies suitable for dumping materials next to the drainfields being constructed. No hauling equipment shall be allowed within the drainfield area or within 50 feet downslope of the drainfield.

#### 3.1.2 Miscellaneous Equipment

Tractors and other equipment shall be of approved types, suitable for constructing drainfields.

### 3.2 GRADE CONTROL

During construction, the lines and grades indicated for the construction of the drainfields shall be maintained by means of line and grade stakes placed by the Contractor in accordance with the SPECIAL CLAUSES.

### 3.3 EXCAVATION FOR DRAINFIELD AND TRANSPORT PIPE

Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with SECTION 02221: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. The subgrade for drainfield aggregate and piping system shall be constructed with furrows parallel to the pipe laterals as shown.

### 3.4 PLACING OF DRAINFIELD AGGREGATE

Drainfield aggregate shall be placed on the prepared subgrade in layers of uniform thickness. The material shall be placed in layers of equal thickness. No layer shall exceed 150 mm or be less than 80 mm when compacted. The layers shall be so placed that when deposited, they will be true to the grade or levels required with the least possible surface disturbance. Drainfield

aggregate shall be placed and leveled to the elevation required for placing the distribution laterals.

### 3.5 INSTALLATION OF PIPE FOR SUBDRAINS

#### 3.5.1 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 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. Thrust blocking shall be placed at appropriate locations according to SECTION 02730: SANITARY SEWERS. All pipes in place shall be approved and tested before backfilling.

#### 3.5.2 Jointings

a. 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.

b. Polyvinyl Chloride (PVC) Pipe: Joints shall be in accordance with the requirements of ASTM D 3034.

#### 3.5.3 Testing

After the distribution laterals have been placed and leveled on the bed of aggregate the manifold pipe attached to the transport pipe and distribution laterals, the system shall be tested in accordance with SECTION: FORCE MAINS AND INVERTED SIPHONS; SEWER.

### 3.6 INSTALLATION OF DRAINFIELD AGGREGATE, FILTER FABRIC, AND BACKFILLING

After pipe for subdrains has been laid, inspected, tested, and approved, drainfield aggregate shall be placed around and over the pipe to the depth indicated. The drainfield aggregate shall be thoroughly compacted by mechanical tampers or rammers to obtain the required density. Compaction of drainfield aggregate and the placement and compaction of overlying backfill material shall be in accordance with the applicable provisions specified in SECTION 02221: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

Filter fabric shall be placed on the drainfield aggregate surface in accordance with the manufacturer's recommended procedures. The surface shall be free of cavities, depressions, or projecting rocks. The fabric shall be laid flat but not stretched and shall be secured with anchor pins. Overlaps shall be at least 457 mm but not less than the manufacturer's recommended overlap. Anchor pins shall be used along the overlaps. Spacing and type of anchor pins shall be as recommended by the fabric manufacturer. The filter fabric shall be protected from exposure to ultraviolet light, and during installation fabric shall be covered the same day that it is laid. Backfill material shall be end dumped on firm ground at the edge of the fabric and spread over the filter fabric material in a manner which prevents damage to the fabric. The pipe distribution system shall be protected from damage due to excessive loading or other Contractor operations. No wheeled equipment shall be drive over the top of the bed where pipes are located or the bed might be damaged.

END OF SECTION

## SECTION 02551

## BITUMINOUS PAVING FOR ROADS, STREETS AND OPEN STORAGE AREAS

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 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 117	(1990) Materials Finer than 75-micrometer (No 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1988) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1984a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 183	(1988) Sampling and the Amount of Testing of Hydraulic Cement
ASTM D 5	(1986) Penetration of Bituminous Materials
ASTM D 75	(1987) Sampling Aggregates
ASTM D 140	(1988) Sampling Bituminous Materials
ASTM D 242	(1985; R 1990) Mineral Filler for Bituminous Paving Mixtures
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 946	(1982) Penetration-Graded Asphalt Cement for Use in Pavement Construction

ASTM D 1250	(1980; R 1990) Petroleum Measurement Tables
ASTM D 1856	(1979; R 1984) Recovery of Asphalt from Solution by Abson Method
ASTM D 2041	(1991) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1992) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1990) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 3381	(1983) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3515	(1989) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 4791	(1989) Flat or Elongated Particles in Coarse Aggregate
CORPS OF ENGINEERS (COE) HANDBOOK FOR CONCRETE AND CEMENT	
CRD-C 119	(1953; Rev Jun 1963) Flat and Elongated Particles in Coarse Aggregate
CRD-C 649	(1995) Standard Test Method for Unit Weight, Marshall Stability, and Flow of Bituminous Mixtures
CRD-C 650	(1995) Standard Test Method for Density and Percent Voids in Compacted Bituminous Pavement Mixtures
CRD-C 651	(1995) Standard Gyrotory Testing Machine Method for Design of Hot-Mix Bituminous Pavement Mixtures
CRD-C 652	(1995) Standard Test Method for Measurement of Reduction in Marshall Stability of Bituminous Mixtures Caused by Immersion

### 1.3 MEASUREMENT AND PAYMENT

#### 1.3.1 Asphalt Tonnage

Quantities of completed asphalt pavement shall be paid for as part of the project lump sum.

### 1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTALS:

Test Reports

The following shall be submitted by the Contractor for approval prior to the start of production and shall meet all requirements specified in PART 2 (PRODUCTS).

- a. Course Aggregate
  - Percentage of wear (ASTM C-131)
  - Percentage of loss (ASTM C-88 and ASTM C-131)
  - Percentage of fractured faces
  - Percent flat and elongated pieces (CRD-C-119)
- b. Fine Aggregate
  - Percent of natural sand content
  - Percent of fractured faces
  - Percentage of loss (ASTM C-88)
- c. Aggregate Gradation
- d. Job Mix Formula plots and test results including index of retained stability, and type of asphalt used.

#### Records

All test results during construction shall be submitted to the Contracting Officer during progress of work.

### 1.5 PLANT, EQUIPMENT, MACHINES, AND TOOLS

#### 1.5.1 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.

#### 1.5.2 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).

#### 1.5.3 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 10-foot 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.

### 1.6 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 40 degrees F or wet. When paving in temperatures below 50 degrees F or during the months between 1 October and 1 April pneumatic tired rollers shall be used as required in paragraph "PLACING". Tack coat shall be applied when temperatures are above 40 degrees F and surfaces are dry.

### 1.7 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.

#### 1.8 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.

##### 1.8.1 Plan Grade

The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

##### 1.8.2 Surface Smoothness

When a 10-foot 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 1/4 inch from the straightedge.

#### 1.9 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 CLAUSES. Finished pavement gradelines and elevations shown shall be established and controlled at site of work by the Contractor.

#### 1.10 SAMPLING AND TESTING

##### 1.10.1 Aggregates

###### 1.10.1.1 General

Samples of aggregates shall be taken by the Contractor prior to the start of production for aggregate quality tests and mix design. 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.

###### 1.10.1.2 Sources

Sources of aggregates shall be selected well in advance of the time the materials are required in the work. Test reports shall be submitted before starting production, indicating that aggregates meet all quality requirements specified herein. 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.

##### 1.10.2 Bituminous Mixtures

Sampling and testing of bituminous mixtures will be accomplished by the Contractor.

#### 1.11 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

##### 1.11.1 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.

#### 1.11.2 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. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

#### 1.12 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

The mix design shall consist of coarse aggregate, fine aggregate, bituminous material, and if required, mineral filler or approved additives, 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 No. 4 sieve shall be known as coarse aggregate, the portion passing the No. 4 sieve and retained on the No. 200 sieve as fine aggregate, and the portion passing the No. 200 sieve as mineral filler. Aggregate gradation shall conform to gradation(s) specified in TABLE I. TABLE I is based on aggregates of uniform specific gravity; the percentage passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentage passing various sieves may be changed by the Contracting Officer when aggregates vary by more than 0.2 in specific gravity.

TABLE I. AGGREGATE GRADATION

	<u>Sieve Size</u>	<u>Percent Passing</u>
Washington	5/8 inch	100
	1/2 inch	90-100
	3/8 inch	75-90
	1/4 inch	55-75
	No. 10	32-48
	No. 40	11-24
	No. 80	6-15
	No. 200	3-7

##### 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 18 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 75 pcf, as determined in accordance with ASTM C 29.

d. Crushed gravel retained on the No. 4 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 COE CRD-C 119.

#### 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 No. 30 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 mixture shall not exceed 25 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic matter. Percentage of loss shall not exceed 15 after five cycles of the soundness test performed in accordance with ASTM C 88, using magnesium sulfate.

#### 2.1.2 Bituminous Material

Asphalt cement shall conform to ASTM D 3381, grade AR 4000W.

### 2.2 PROPORTIONING OF MIXTURE

#### 2.2.1 Job Mix Formula

The Job-Mix Formula shall be developed by the Contractor using CRD-C 649, 650, 651, and 652. The mix design shall meet the test requirements presented in this section and shall show the following:

- a. Graphical Plots for a minimum of 4 asphalt contents for

Stability	vs. A/C content
Unit wt. Mix	vs. A/C content
Percent Total Voids Filled	vs. A/C content
Percent Voids, Total Mix	vs. A/C content
Flow	vs. A/C content

The optimum asphalt content shall be calculated by averaging the peaks of curves 1 thru 4 and the stability, flow, and voids must fall within criteria specified in paragraph: Test Properties of Bituminous Mixtures.

- b. The percentage and specific gravity of each bin fraction of aggregate. (This will be used to determine the theoretical specific gravity.)

- c. Absorption of the entire blend.
- d. Specific gravity of the asphalt.
- e. Reduction in Stability by Immersion.

Previously established test results will be accepted provided that the tests were performed within the last 2 years and conform to requirements specified above. The job-mix-formula will be allowed tolerances given in Table 2 herein.

TABLE II. JOB-MIX TOLERANCES

<u>Material</u>	<u>Tolerance, Plus or Minus</u>
Aggregate passing No. 4 sieve or larger	5 percent
Aggregate passing Nos. 8, 16, 30, and 50 sieves	4 percent
Aggregate passing Nos. 100 and 200 sieves	2 percent
Bitumen	0.30 percent
Temperature of mixing	25 degrees F

## 2.2.2 Test Properties of Bituminous Mixtures

Finished mixture shall meet requirements described below when tested in accordance with CRD-C 649, 650, 651, and 652. All samples will be compacted with 50 blows of specified hammer on each side of sample. The bituminous mixture shall meet the requirements specified below.

## 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

Stability minimum, pounds	1000
Flow maximum, 1/100-inch units	20
Voids total mix, percent (1)	3-5
Voids filled with bitumen, percent (2)	75-85

TABLE IV. ABSORPTIVE-AGGREGATE MIXTURE

Stability minimum, pounds	1000
Flow maximum, 1/100-inch units	20
Voids total mix, percent (1)	2-4
Voids filled with bitumen, percent (2)	80-90

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 127 and 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 CRD-C 650, or 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 CRD-C 652. When the index of retained stability is less than 75, the aggregate stripping tendencies may be countered by the use of hydrated lime. The hydrated lime is considered as mineral filler and should be considered in the gradation requirements. The amount of hydrated lime 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 lime antistripping agent required.

#### 2.3 Tack Coat Materials

Emulsified asphalt for tack coat materials shall conform to ASTM D 977 and D 2397 grades RS-1, SS-1, SS-1h, CRS-1, CSS-1, or CSS-1h.

### 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 02241: BASE COURSE. Unsatisfactory areas shall be corrected.

#### 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 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

#### 3.4 STORAGE OF BITUMINOUS PAVING MIXTURE

Storage shall conform to the applicable requirements of ASTM D 3515.

#### 3.5 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 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.

#### 3.6 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing the underlying course shall be cleaned of all foreign or objectionable matter. Power brooms and hand brooms shall be used to clean underlying asphalt courses.

#### 3.7 TACK COATING

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a tack coat. Tack coat shall be

applied at the rate of .05 to .15 gallons per square yard. The exact quantities within the ranges specified may be varied to suit field conditions.

### 3.7.1 Application

Following preparation and subsequent inspection of the surface, a tack coat shall be applied at the specified rate with uniform distribution over the surface to be treated. Following application of the tack coat and prior to application of the pavement, the material shall be allowed to cure (all moisture must be allowed to evaporate out of the emulsion). The tacked area shall be maintained by protecting the surface against damage and by repairing and retacking deficient areas at no additional cost to the Government. No more tack coat material shall be placed than can be covered in the same day. If required, clean, dry sand shall be spread to effectively blot up excess bituminous material.

## 3.8 PLACING

Bituminous courses shall be constructed only when the base course or existing pavement is dry. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided. If bituminous materials are placed in more than 1 lift, the longitudinal joints shall be offset by at least 1 foot. The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided specification densities are attained. An exception shall be that the pneumatic tired roller shall be used between 1 October and 1 April or when ambient temperature is below 50 degrees F. Coverages with a vibratory steel wheel roller may precede pneumatic tired rolling.

### 3.8.1 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 225 degrees F 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. 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.

### 3.8.2 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 2 to 3 inches 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.

### 3.8.3 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.

### 3.9 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. Vibratory rollers shall not be operated in the vibratory mode when the internal temperature of the mix is less than 175 degrees F. Tests for smoothness shall be made by the Contractor during construction. Deficiencies shall be corrected so that the finished course will conform to requirements for smoothness specified herein. Rolling shall be continued until a mat and joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. After paving operations are complete, crown, grade, and smoothness will be checked by the Contractor for compliance and will be evaluated as specified in paragraph "ACCEPTABILITY OF WORK."

#### 3.9.1 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 a bituminous tack coat. 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.

### 3.10 JOINTS

#### 3.10.1 General

Joints between old and new pavements, between successive work days, or joints that have become cold (less than 175 degrees F) shall be cut back and tack coated to insure continuous bond and proper compaction between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Tack coat 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.

#### 3.10.2 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.

#### 3.10.3 Longitudinal Joints

Edges of a previously placed strip shall be prepared as specified above and 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."

### 3.11 ACCEPTABILITY OF WORK

#### 3.11.1 General

A lot shall be that quantity of construction that will be evaluated for compliance with specification requirements. A lot shall be equal to one days production. The Contractor shall perform all tests as specified herein at the frequency specified in Section titled: CONTRACTOR QUALITY CONTROL.

#### 3.11.1.1 Lot Evaluation

Each lot shall be evaluated for gradation, asphalt content, density, and surface smoothness.

#### 3.11.1.2 Lot Failure

When a lot of material fails to meet the specification requirements, that lot shall be removed and replaced.

#### 3.11.2 Aggregate Gradation

The aggregate gradation shall fall within the job mix tolerances specified in Table II.

#### 3.11.3 Asphalt Content

The asphalt content must be within 0.30 percent of the job mix formula.

#### 3.11.4 Density

The average mat and joint densities will be expressed as a percentage of the laboratory density. The laboratory density for each lot will be determined in accordance with CRD-C 650.

##### 3.11.4.1 Field Density

The field density shall be determined and the average mat and joint density shall be 95 percent compacted specimens of the same mixture.

#### 3.11.5 Surface Smoothness

After completion of final rolling of a lot, the compacted surface will be tested by the Contractor in the presence of a Contracting Officer with a 10-foot straightedge. Measurements will be made perpendicular to and across all mats at distances along the mat not to exceed 25 feet. Location and deviation from straightedge of all measurements will be recorded. Any joint or mat area surface deviation which exceeds the tolerance given in paragraph "GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS" by more than 50 percent shall be corrected to meet the specification requirements. The Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

END OF SECTION

## SECTION 02577

## 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-115 (Rev F) Paint, Traffic (Highway, White, and Yellow)

## 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 SUBMITTALS:

## 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.

## Reports

Material Tests; GA.

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.

## 1.3 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.

## 1.4 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.

## 1.4.1 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 5 mph, 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. 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.

#### 1.4.2 Surface Preparation Equipment

##### 1.4.2.1 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.

##### 1.4.2.2 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.

#### 1.4.3 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.

#### 1.5 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. Paint for roads and streets shall conform to FS TT-P-115, color as indicated.

### 2.2 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 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.

##### 3.1.2 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. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. 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 40 degrees F and less than 95 degrees F. 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

Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 10 plus or minus 0.5 square meters per liter. Glass spheres shall be applied uniformly to the wet paint on road and street pavement at a rate of 1.2 plus or minus 0.6 kilograms of glass spheres per gallon of paint.

##### 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 02630

## 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 33 (1981) Preformed Expansion Joint Filler for Concrete (Bituminous Type)
- AASHTO M 198 (1975; Rev. 1986) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
- AASHTO M 199 (1987I) Precast Reinforced Concrete Manhole Sections
- AASHTO M 242 (1997I) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
- AASHTO M 252 (1985) Corrugated Polyethylene Drainage Tubing
- AASHTO M 299 (1986) Corrugated Polyethylene Pipe, 300 mm to 600 mm dia.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 48 (1983) Gray Iron Castings
- ASTM A 536 (1984) Ductile Iron Castings
- ASTM B 26 (1986) Aluminum-Alloy Sand Castings
- ASTM C 231 (1982) Air Content of Freshly Mixed Concrete by the Pressure Method
- ASTM C 270 (1987; Rev. A) Mortar for Unit Masonry
- ASTM C 443 (1985; Rev. A) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- ASTM C 478 (1987) Precast Reinforced Concrete Manhole Sections
- ASTM C 655 (1985; Rev. A) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
- ASTM D 1556 (1982) Density of Soil In-Place by the Sand Cone Method
- ASTM D 1751 (1983) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

- ASTM D 1752 (1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- ASTM D 2167 (1984) Density and Unit Weight of Soil In-Place by the Rubber-Balloon Method
- ASTM D 3034 (1985; Rev. B) Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
- ASTM D 3212 (1986) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

FEDERAL STANDARD (FED-STD)

- FED-STD 601 (Change Notices 1 thru 7) Rubber: Sampling and Testing

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-75, 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 shall be furnished to the Contracting Officer prior to installation.

Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 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.

1.3.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition. Pipe shall be carried 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 for the following pertinent types:

### 2.1.1 Reinforced Concrete Pipe

ASTM C 76 or AASHTO M 170 Class III, or ASTM C 655 or AASHTO M 242, 1500-D load

### 2.1.2 Polyvinyl Chloride (PVC) Pipe

ASTM D 3034, Type PSM, SDR-35.

### 2.1.3 Corrugated Polyethylene (PE) Pipe

AASHTO M 252 or AASHTO M 294.

## 2.2 DRAINAGE STRUCTURES

### 2.2.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal, complete with frames and covers or gratings and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated.

## 2.3 MATERIALS FOR DRAINAGE STRUCTURES

### 2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 28 MPA concrete under Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. 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 40 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 80 mm between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, ASTM D 1752, or AASHTO M 33, 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 but in no case shall exceed 7 gallons of water per sack of cement. 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 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478 or AASHTO M 199. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph "JOINTS".

### 2.3.4 Prefabricated Corrugated Metal Manholes

Manholes shall be of the type and design recommended by the manufacturer. Manholes shall be complete with frames and cover, or frames and gratings.

### 2.3.5 Frame and Cover or Gratings

Frame and cover or gratings shall be cast gray iron, ASTM A 48 or AASHTO M 105, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26, Alloy 356.OT6. Reinforced concrete shall conform to the requirements of Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. Proof load test, test bars, and certification shall be provided for any component which must support a structural live load.

## 2.4 STEEL LADDERS

Steel ladders shall be provided where the depth of the manhole exceeds 18 meters. These ladders will be not less than 500 mm in width with 20 mm diameter rungs spaced 300 mm apart. Ladders shall be adequately anchored to the wall by means of steel inserts spaced not more than 1.5 meters apart vertically and shall be so installed as to provide at least 165 mm of space between wall and inside of rungs. The 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.

## 2.5 JOINTS

### 2.5.1 For Concrete Pipe

#### 2.5.1.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443 or AASHTO M 198. 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 1,350 mm.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph "HYDROSTATIC TEST ON WATERTIGHT JOINTS." Gaskets or jointing materials shall not swell more than 100 percent by volume when immersed in accordance with Method 6211 of FED-STD 601 in immersion medium No. 3 for 70 hours at 100 degrees C. 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.

c. Installation: 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.

#### 2.5.2 For Polyvinyl Chloride (PVC) Pipe

Joints shall be in accordance with the requirements of ASTM D 3212.

#### 2.5.3 For Corrugated Polyethylene (PE) Pipe

Use couplings and fittings recommended by the pipe manufacturer.

### 2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

#### 2.6.1 Tests for Concrete and PVC 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 AASHTO M 198 or ASTM C 443. Test requirements for joints in clay pipe shall conform to ASTM C 425. Test requirements for joints in asbestos cement pipe shall conform to ASTM C 500. Test requirements for joints in PVC 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 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and the following requirements:

#### 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 (O.D.) of the pipe plus 600 mm for pipes of less than 60 mm inside diameter, and shall not exceed 900 mm plus pipe O.D. for larger sizes 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.

### 3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. When no bedding class is specified or detailed on the drawings, concrete and asbestos-cement 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. Bedding for clay pipe shall be as specified by ASTM C 12. Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A 798. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, it is recommended to either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow V-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A 807. Bedding for PVC pipe shall meet the requirements of ASTM D 2321. Bedding for corrugated PE pipe shall also meet requirements of ASTM D 2321. Bedding for ductile iron culvert pipe shall meet requirements of AASHTO M 64.

### 3.3 PLACING PIPE

Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. 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. All pipe in place shall be inspected before backfilling, and those pipes damaged during placement shall be removed and replaced.

#### 3.3.1 Concrete and PVC 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 Corrugated Polyethylene (PE) Pipe

Laying shall be with the separate sections joined firmly, and shall follow manufacturer's recommendations.

### 3.4 BACKFILLING

#### 3.4.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, 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 insure 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 150 mm close thickness for compaction by hand operated machine compactors, and 200 mm loose thickness for other than hand operated machines. Tests for density will be made as necessary to insure 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.

#### 3.4.2 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 3.65 meters, 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 150 mm close thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines.

#### 3.4.3 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 pipe damaged thereby shall be repaired or replaced.

#### 3.4.4 Compaction

##### 3.4.4.1 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.

##### 3.4.4.2 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.

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.

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.

Under nontraffic areas, density shall be not less than that of the surrounding material.

#### 3.4.5 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 insure that specified density is being obtained. Minimum number of tests shall be in accordance with Section 01400, Contractor Quality Control. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557, Method D, 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 1556. Test results shall be furnished the Contracting Officer.

#### 3.5 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 0.6 meters 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 0.6 meters 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 0.75 liters per 25 mm in diameter per 30 meters 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 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 184 | (1990) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement   |
| 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 595 | (1995a) Blended Hydraulic Cements                                      |
| 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 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
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
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop
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.

## 1.4 ACCEPTABILITY OF WORK

The pavement will be accepted on the basis of tests made by the Government and 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 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 (6 by 12 inch) 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

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 (1/8 inch) 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

<u>Pavement Category</u>	<u>Direction of Testing</u>	<u>Tolerances, mm</u>
Roads and Streets	Longitudinal	5
	Transverse	6.5
Tank Hardstands, Parking Areas, Open Storage 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 (15 feet) 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 any 255 mm (10 inch) or thicker slab of the slipformed portion of the pavement, shall have an edge slump exceeding 6 mm (1/4 inch) and no slab shall have an edge slump exceeding 9 mm. (3/8 inch.) 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 (5 to 15 foot) 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 (0.04 foot) above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 18 mm (0.06 foot) 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 30 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 01330 SUBMITTAL PROCEDURES:

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.

## Schedules

Paving; FIO.

Paving Schedules at least 7 days prior to start of paving.

## 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 and/or truck mixers. 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, (30 inches,) and the outside vibrators shall not exceed 300 mm (12 inches) 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 (10 inches) or less in thickness, where longitudinal and transverse surface smoothness tolerances are 6.5 mm (1/4 inch) 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 (12 to 18 inches) 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 (4 feet) 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 (12 foot) 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 and pozzolan or portland cement in combination with pozzolan shall conform to appropriate specifications listed below.

## 2.1.1 Portland Cement

Portland cement shall conform to ASTM C 150 Type II, low-alkali.

## 2.1.4 Pozzolan (Fly Ash)

Fly ash shall conform to ASTM C 618 Class F, including all the supplementary optional physical requirements.

## 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.

## 2.2.1 Coarse Aggregate

Coarse aggregate shall consist of crushed gravel, crushed stone, or a combination thereof. The nominal maximum size of the coarse aggregate shall be 19.0 mm (3/4 inches). When the nominal maximum size is greater than 25.0 mm, (1 inch,) 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 (No. 200) sieve).
- d. The separation medium for lightweight particles shall have a density of 2.0 Mg/cubic meters. (Sp. Gr. of 2.0.)

## 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. 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 33 and 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. (Sp. Gr. of 2.0.)
- 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 494 Type 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 1752 Type I, II, or III, and compatible with the approved joint sealant material. Expansion joint filler shall be 20 mm (3/4 inch) thick.

#### 2.6.2 Slip Joint Material

Slip joint material shall be 6 mm (1/4 inch) thick expansion joint filler conforming to ASTM D 1751 or ASTM D 1752.

### 2.7 REINFORCING

Reinforcing bars shall conform to ASTM A 615 Grade 60. Bar mats shall conform to ASTM A 184. Reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete.

### 2.8 DOWELS

#### 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 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to ASTM C 881, Class as appropriate for each application temperature to be encountered; except, that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching for complete filling of spalls, wide cracks, and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed portland cement concrete, mortar, or freshly mixed epoxy resin concrete to hardened concrete shall be Type V, Grade as approved.

## 2.10 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

Specified compressive strength,  $f'c$ , for concrete is 28 MPa (4000 psi) 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 6 plus or minus 1 percent. The maximum allowable slump of the concrete shall be 75 mm (3 inches) for pavement constructed with fixed forms. For slipformed pavement, the maximum allowable slump shall be 30 mm (1-1/4 inches). 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. (500 psi.) 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 retarder or 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, 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. (90 degrees F.) Steel forms, dowels and reinforcing shall be cooled prior to concrete placement when steel temperatures are greater than 49 degrees C. (120 degrees F.)

#### 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. (40 degrees F.) The temperature of the concrete when placed shall be not less than 10 degrees C. (50 degrees F.) 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. 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 (50 degrees F) 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, (90 degrees F,) 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 and/or slipforms.

### 3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 50 mm. (2 inches.) 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. (8 inches.)

### 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-finisher 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 (150 feet) 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 (8 inches) 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.

#### 3.4.6 Placing Reinforcing Steel

Reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement, or may be placed on an initial layer of consolidated concrete, with the subsequent layer placed within 30 minutes of the first layer placement.

#### 3.4.7 Placing Dowels

Dowels shall be installed with alignment not greater than 1 mm per 100 mm. (1/8 inch per ft.) Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 15 mm (5/8 inch) and a vertical tolerance of plus or minus 5 mm. (3/16 inch.) 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 Contraction Joints

Dowels in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

##### 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 (1/8 inch) 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.

### 3.5 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 (10 to 12 feet) 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 (10 to 12 feet) 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 (1/2 inch) 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 (1/16 inch) in depth but not more than 3 mm (1/8 inch) 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 (1/8 inch) 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, spanning the newly paved lane. The curing compound shall be applied at a maximum application rate of 5 square meters per L. (200 square feet per gallon.) 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. (1/2 inch.)

### 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 doweled.

### 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 thickened edges 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 (1/8 inch) 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.

### 3.8 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 (6 inch) 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, dowels, or tie bars are present along any edges, these edges shall be sawed full depth 150 mm (6 inches) from the edge if only keys are present, or just beyond the end of dowels or tie bars if they are present. These joints shall then be carefully sawed on the joint line to within 25 mm (1 inch) 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 (4 inches) deep occurs, the entire slab containing the underbreak shall be removed and replaced. Where there are no dowels, tie bars, 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 or tie bars shall be cut off flush with the joint face. All four edges of the new slab shall thus contain dowels or original keys or original tie bars. 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 (1 inch) outside the spalled area and to a depth of at least 50 mm. (2 inches.) 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 (1/3 cu. ft.) in size after removal operations; portland cement mortar shall be used for spalls between 0.00085 and 0.009 cubic meter; (0.03 and 1/3 cu. ft;) and epoxy resin mortar or Type III, Grade 3 epoxy resin for those spalls less than 0.00085 cubic meter (0.03 cu. ft.) in size after removal operations. Portland cement concretes and mortars shall be very low slump mixtures, proportioned, mixed, placed, tamped, and cured. 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 (6 inches) in maximum dimension, may be prepared by drilling a core 50 mm (2

inches) in diameter greater than the size of the defect, centered over the defect, and 50 mm (2 inches) deep or 13 mm (1/2 inch) 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. (1/4 inch.) All pavement areas requiring plan grade or surface smoothness corrections in excess of the specified limits, shall be removed and replaced. In pavement areas given a wire comb or tined texture, areas exceeding 2 square meters (25 square feet) that have been corrected by rubbing or grinding shall be retextured by grooving machine sawn grooves meeting the requirements for the wire comb or tined texture. 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, (yd,) amount of water as free moisture in each size of aggregate, and the batch aggregate and water masses per cubic meter (yd.) 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, reinforcing, 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 (square feet per gallon) 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. A copy of weekly reports shall be faxed to the Design District Pavement or Geotechnical Engineer. 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. A copy of the certification report shall be mailed to the Design District pavement or Geotechnical Engineer.

END OF SECTION

## SECTION 02760

FIELD MOLDED SEALANTS FOR SEALING JOINTS AND CRACKS IN RIGID PAVEMENT AND  
CONTAINMENT BASIN

## 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)                      |
| ASTM D 3569 | (1985; R 1991) Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements |

## CORPS OF ENGINEERS (COE)

- |               |  |
|---------------|--|
| COE CRD-C 525 | (1989) Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating |
|---------------|--|

## 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 |
|-------------|--|

## 1.3 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:

## 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, 60 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.

## 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.

#### Samples

Materials; GA.

Samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 60 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

#### 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 60 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 Tractor-Mounted Routing Tool

The routing tool used for removing old sealant from the joints shall be of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

###### 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 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening should not exceed 6.4 mm (1/4 inch). The air compressor shall be portable and shall be capable of furnishing not less than 71 liters per second (150 cubic feet per minute) and maintaining a line pressure of not less than 621 kPa (90 psi) at the nozzle while in use. Compressor capability under job conditions must be demonstrated before approval. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. 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 adjusted as necessary to secure satisfactory results.

#### 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 Hot-Poured Sealing Equipment

The unit applicators used for heating and installing ASTM D 3569 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

##### 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 (90 degrees F). 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 (10 to 60 gallons) per hour and through a range of application pressures from 345 kPa to 10.3 MPa (50 to 1500 psi) 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.

#### 1.6.2.3 Two-Component, Cold-Applied, Hand-Mix Sealing Equipment

Mixing equipment for FS SS-S-200 Type H sealants shall consist of a slow-speed electric drill or air-driven mixer with a stirrer in accordance with the manufacturer's recommendations.

### 1.7 TRIAL JOINT SEALANT INSTALLATION

Prior to the cleaning and sealing of the joints for the entire project, a test section of at least 30 m (100 feet) long shall be prepared using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, the test section shall be inspected to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. All other joints shall be prepared and sealed in the manner approved for sealing the test section.

### 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 (50 degrees F) 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 joints and cracks in all portland cement concrete paved areas indicated on the drawings, shall be ASTM D 3569 or FS SS-S-200 Type M or H.

### 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 (5 degrees F) 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 (5 degrees F) 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 (1/8 inch) 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, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

##### 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 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 to remove all saw cuttings and debris.

###### 3.1.2.2 Refacing of Random Cracks

Sawing of the cracks shall be accomplished using a power-driven concrete saw as specified in paragraph EQUIPMENT. The saw blade shall be 152 mm (6 inches) or less in diameter to enable the saw to follow the trace of the crack. The blade shall be stiffened as necessary with suitable dummy (or used) blades or washers. Immediately following the sawing operation, the crack opening shall be thoroughly cleaned using a water jet to remove all saw cuttings and debris.

##### 3.1.3 Sandblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 13 mm (1/2 inch) from the joint edges shall be sandblasted or waterblasted clean. A multiple-pass technique shall be used until the surfaces are free of dust, dirt, curing compound, filler, old sealant 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 sandblasting, 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 Hot-Poured Sealants

Sealants conforming to ASTM D 3569 shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on the sealant containers. Sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation shall be withdrawn and wasted.

### 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 (90 degrees F) 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.

### 3.2.3 Type H Sealants

The FS SS-S-200 Type H sealant components shall be mixed either in the container furnished by the manufacturer or a cylindrical metal container of volume approximately 50 percent greater than the package volume. The base material shall be thoroughly mixed in accordance with the manufacturer's instructions. The cure component shall then be slowly added during continued mixing until a uniform consistency is obtained.

## 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 (50 feet) 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 6 mm (1/4 inch) plus or minus 1.5 mm (1/16 inch) 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

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## SECTION 02831

## CHAIN LINK FENCE

## 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 94 (1992a) Ready-Mixed Concrete

ASTM F 883 (1990) Padlocks

## AMERICAN WELDING SOCIETY (AWS)

AWS WZC (1972) Welding Zinc-Coated Steels

## FEDERAL SPECIFICATIONS (FS)

FS RR-F-191/GEN (Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories)

FS RR-F-191/1 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)

FS RR-F-191/2 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Gates)

FS RR-F-191/3 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

FS RR-F-191/4 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

## PART 2 PRODUCTS

## 2.1 MATERIALS

Materials shall conform to the following:

## 2.1.1 Chain Link Fence

FS RR-F-191/GEN.

## 2.1.1.1 Fabric

FS RR-F-191/1, Type I, zinc-coated steel wire with minimum coating weight of 610 grams of zinc per square meter of coated surface, or Type II, aluminum-coated steel wire. Fabric shall be fabricated of 9-gauge wire woven in 50.8 mm mesh. Fabric height shall be ~~1.83 meters~~ as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

## 2.1.1.2 Gates

FS RR-F-191/2. Gate shall be the type and swing shown. Gate frames shall be constructed of Class 1 Grade A or B, steel pipe, size SP2, as specified in FS RR-F-191/3. Gate fabric shall be as specified for chain-link fabric. Each

end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Gate leaves more than 2.44 meters wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position.

#### 2.1.1.3 Posts

FS RR-F-191/3, zinc-coated; Class 1 Grade A or B, steel pipe; Class 3, formed steel sections; or Class 6, steel square sections. Class 4, steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same class throughout the fence. Gate post shall be either round or square, subject to the limitation specified in FS RR-F-191/3.

#### 2.1.1.4 Braces and Rails

FS RR-F-191/3, zinc-coated, Class 1, Grade A or B, steel pipe, size SP1. Class 3, formed steel sections, size FS1, conforming to FS RR-F-191/3, may be used as braces if Class 3 line posts are furnished.

#### 2.1.1.5 Accessories

FS RR-F-191/4. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be zinc or aluminum coated, 4 point barbed type, steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9-gauge steel wire.

#### 2.1.2 Concrete

ASTM C 94, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

#### 2.1.3 Padlocks

ASTM F 883, Type P01, Grade 2, Size 44.4 mm. Padlocks shall be keyed alike and each lock shall be furnished with two keys.

### PART 3 EXECUTION

#### 3.1 GENERAL

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 3.05 m. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m. Damage to the

galvanized surface due to welding shall be repaired with "repair sticks" of zinc-cadmium alloys or zinc-tin-lead alloys per AWS WZC.

### 3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 50.8 mm clearance between the bottom of the fabric and finish grade.

### 3.3 POSTS

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 457 mm in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Class 3 line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 914 mm and shall be protected with drive caps when being set. Fence post rigidity shall be tested by applying a 222.4 newtons force on the post, perpendicular to the fabric, at 1.52 m above ground. Post movement measured at the point where the force is applied shall be less than or equal to 19 mm from the relaxed position. Every tenth post shall be tested for rigidity. When a post fails this test, further tests on the next four posts on either side of the failed post shall be made. All failed posts shall be removed, replaced, and retested at the Contractor's expense.

### 3.4 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 1.83 m in height. A center brace or 2 diagonal truss rods shall be installed on 3.66 m fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m high or less if a top rail is installed.

### 3.5 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 305 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

### 3.6 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm intervals. The fabric

shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm intervals and fastened to all rails and tension wires at approximately 610 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 inches.

### 3.7 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored to the posts in a manner to prevent easy removal with hand tools. Supporting arms shall be anchored with 9.5 mm diameter plain pin rivets or, at the Contractor's option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Studs driven by an explosive-actuated tool shall not be used with gray iron or other material that can be fractured. A minimum of two studs per support arm shall be used. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

### 3.8 GATES

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Padlocks shall be attached to gates or gate posts with chains and hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

### 3.9 GROUNDING

Fences crossed by overhead powerlines in excess of 600 volts shall be grounded as specified in Section 16670 LIGHTNING PROTECTION SYSTEM. Electrical equipment attached to the fence shall be grounded as specified in Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

END OF SECTION

NEW SECTION ADDED BY AMENDMENT R0005

## SECTION 02935

## DRYLAND SEED APPLICATION

## PART 1 - GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 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 (Sep 1997; Amended Oct 29, 1986) Federal Seed Act Regulations(Part 20): Certified Seed Regulations

## FEDERAL SPECIFICATIONS

FS JJJ-S-181 (Rev B) Seeds, Agricultural

## 1.3 SUBMITTALS

Submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS.

## Data

Manufacturer's Literature; FIO.

Manufacturer's literature discussing physical characteristics, application and installation instructions for erosion control material.

## Schedules

Equipment List; FIO.

A list of proposed seeding equipment to be used in performance of seeding operation, including descriptive data and calibration tests.

## Statements

Delivery; FIO.

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

## Certificates

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of the materials. Certified copies of the reports for the following materials shall be included:

a. Seed: For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, maximum percent other crop and/or inert, date tested and state certification.

#### 1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

##### 1.4.1 Inspection

Seed shall be inspected upon arrival at the job site by the Contracting Officer's Representative 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.

##### 1.4.2 Storage

Materials shall be stored in areas designated by the Contracting Officer. Seed shall be stored in cool, dry locations away from contaminants.

##### 1.4.3 Handling

Except for bulk delivers, materials shall not be dropped or dumped from vehicles.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

###### 2.1.1 Seed

###### 2.1.1.1 Seed Classification

State-certified 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 accordance with AMS-01 and Washington State Seed Standard WAC 16-316-370.

###### 2.1.1.2 Seed Mixtures

Seed mixtures shall be proportioned by weight as follows:

<b>SPECIES</b>		<b>POUNDS OF PURE LIVE SEED PER ACRE</b>
Pseudorognaria spicata	Bluebunch wheatgrass	4
Poa ampla	Sherman big bluegrass	2
Oryzopsis hymenoides	Indian ricegrass	1-1/2
Elymus lanceolatus	Thickspike wheatgrass	1
Agropyron fragile	Siberian wheatgrass	2

<b>SPECIES</b>		<b>POUNDS OF PURE LIVE SEED PER ACRE</b>
----------------	--	--

Elytrigia intermedia	Intermediate wheatgrass	1
Achilles millefolium	Western Yarrow	1/4
Lupinus albicaulis	Sickle-keeled lupine	1/2

#### 2.1.1.3 Quality

Seed shall conform to FS JJJ-S-181. Weed seed shall not exceed 1 percent by weight of the total mixture. One percent maximum other crop and/or inert. Wet, moldy, or otherwise damaged seed shall be rejected.

#### 2.1.1.4 Seed Mixing

The field mixing of seed shall be performed on site in the presence of the Contracting Officer's Representative.

#### 2.1.2 Water

Water shall be the responsibility of the Contractor unless otherwise noted. Water shall not contain elements toxic to the plant life.

### PART 3 EXECUTION

#### 3.1 SEEDING TIMES AND CONDITIONS

##### 3.1.1 Seeding Time

Seed shall be sown from 15 September through 1 November for fall planting.

##### 3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, frozen ground, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the Seeding Operations, proposed times shall be submitted to and approved by the Contracting Officer's Representative.

#### 3.2 SITE PREPARATION

##### 3.2.1 Tillage

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of 4 inches. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1-vertical, the soil shall be tilled to a minimum depth of 2 inches 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.

##### 3.2.2 Finished Grading

Areas compacted by construction operations shall be completely pulverized by tillage and returned to the original slope, grade and contour. Soil used for repair of erosion or grade deficiencies shall conform to requirements

specified for satisfactory fill. Drainage patterns shall be maintained as indicated on drawings. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. Seeded areas shall be smooth graded and blended to existing areas.

### 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 seeding shall be subject to the inspection and approval of the Contracting Officer's Representative prior to commencement of seeding operations. Immediately prior to the commencement of seeding operations, the Contractor shall conduct seeding equipment calibration tests in the presence of the Contracting Officer's Representative.

#### 3.3.3 Applying Seed

The following seeding methods shall be utilized by the Contractor based on the size of the area to be seeded and the slopes/terrain of the areas to be seeded.

##### 3.3.3.1 Drill Seeding

Drill seeding shall be performed in areas 1/2 acre or greater in size and in areas with slopes of 5 percent or less. Seed shall be uniformly drilled to an average depth of 1/2 inch and at the rate specified above using equipment having drills not more than 12 inches apart. A lightweight drag device (drag chains) shall be installed and function to drag behind each disk row to adequately cover the seed.

##### 3.3.3.2 Broadcast Seeding

Broadcast seeding shall be performed in areas less than 1/2 acre in size or where slopes exceed 5 percent. Seed shall be uniformly distributed at the rates specified above to any given site. Following application, sites less than 10 percent slope shall be harrowed lightly to incorporate the seed into the soil. On sites greater than 10 percent slope, an erosion control cover, such as straw, mulch, or commercially available erosion control blanket shall be applied to the site. Application of any straw, mulch or erosion control blanket must be done so in such manner as to prevent the material from being removed from the site for the first 6 months by natural causes (i.e. wind and stormwater runoff events). As an alternative, the Contractor may substitute hydroseeding as a means of broadcast application.

### 3.4 ESTABLISHMENT PERIOD

#### 3.4.1 Satisfactory Stand

A satisfactory stand from the seeding operation for a field area is defined as a minimum of 15 grass plants per square foot. The total bare spots shall not exceed 5 percent of the total seeded area.

### 3.5 FINAL ACCEPTANCE

### 3.5.1 Preliminary Inspection

Prior to the completion of the 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 Establishment Period shall be determined. An unacceptable stand shall be repaired as soon as seeding conditions permit.

### 3.5.2 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.

## 3.6 SEEDING AREA

Seeding is required in areas disturbed by construction or construction equipment; such as disturbed areas adjacent to road cuts, culvert placement, geocellular ford crossings, gabion installation, barb installation, stockpile locations, and staging areas.

END OF SECTION

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## SECTION 03100

## STRUCTURAL CONCRETE FORMWORK

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 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 CONCRETE INSTITUTE (ACI)

ACI 347 (1978; Rev. 1984) Recommended Practice for  
Concrete Formwork

## U.S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS (NBS)

NBS PS 1 (1983) Construction and Industrial Plywood

## 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 SUBMITTALS:

Design Analysis and Calculations; FIO.

Design analysis and calculations for form design and methodology used in the design shall be submitted.

Manufacturer's Catalog Data; GA.

Manufacturer's data shall include literature describing form materials, accessories, and form releasing agents.

Detail Drawings; FIO.

Drawings showing details of formwork including joints, supports, studding and shoring, and sequence of form and shoring removal.

Manufacturer's Instructions; GA.

Manufacturer's recommendation on method and rate of application shall be provided.

## 1.4 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347 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 CONCRETE FOR BUILDING CONSTRUCTION. 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 C Finish

All surfaces which shall remain exposed in the completed construction shall have a Class C finish. Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to NBS PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to ANSI 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.

### 2.1.2 Form Ties

Form ties shall be factory-fabricated metal or fiberglass ties. 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 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter. Fiberglass ties shall be removed by grinding to expose a smooth finished surface.

### 2.1.3 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

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION and conforming to construction tolerance given in TABLE 1. 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 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 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. Supporting forms and shores shall not be removed from 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 the walls and in arises	Maximum for entire length -----25mm
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 10 feet of length -----6mm In any bay or in any 6 m of length - 10 mm
a. In the slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length -----20 mm
b. In exposed lintels, sills, parapets, 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 mm -----13 mm Maximum -----25 mm
4. Variation of distance between walls	6 mm per 3 m of distance, but not more than 13 mm in one bay, and not more than 25 mm total variation
5. Variation in the sizes and locations of sleeves, floor openings, and wall openings	Minus -----6 mm Plus -----13 mm
6. Variation in cross-sectional dimensions of and in the thickness of slabs and walls	Minus -----6 mm Plus -----13 mm

## 7. Footings:

- |    |                                 |   |
|----|---------------------------------|---|
| a. | Variation of dimensions in plan | Minus -----13 mm<br>Plus -----50 mm<br>when formed or plus 3 inches when placed against unformed excavation |
| 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 03301

## CONCRETE FOR BUILDING CONSTRUCTION

## 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 318/318R (1989; Rev 1992; Errata) Building Code Requirements for Reinforced Concrete

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615 (1994) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 94 (1994) Ready-Mixed Concrete

ASTM C 309 (1993) Liquid Membrane-Forming Compounds for Curing Concrete

## 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:

## Certificates

Cementitious Materials; GA.

Cement, pozzolan, and ground iron blast-furnace slag will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished. No cement, pozzolan, or slag shall be used until notice of acceptance has been given by the Contracting Officer. Cement, pozzolan, and slag may be subjected to check testing by the Government from samples obtained at the mill, at transfer points, or at the project site.

## 1.3 GENERAL REQUIREMENTS

## 1.3.1 Strength Requirements

Structural concrete for all work shall have a 28-day compressive strength of 28 MPa. (4000 pounds per square inch.) Concrete slabs on-grade, as indicated, shall have a 28-day flexural strength of 4 MPa. (600 pounds per square inch.) 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.

## 1.3.2 Air Entrainment

All concrete shall contain from 4 to 7 percent total air.

### 1.3.3 Special Properties

Concrete may contain other admixtures, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if approved.

### 1.3.4 Slump

Slump shall be within the following limits:

<u>Structural Element</u>	<u>*Slump in millimeters</u>	
	<u>Minimum</u>	<u>Maximum</u>
Foundation walls, substructure walls, footings, pavement, and slabs	25	75
Any structural concrete approved for placement by pumping	None	150

<u>Structural Element</u>	<u>*Slump in inches</u>	
	<u>Minimum</u>	<u>Maximum</u>
Foundation walls, substructure walls, footings, pavement, and slabs	1	3
Any structural concrete approved for placement by pumping	None	6

\*Where use of superplasticizers are approved to produce flowing concrete these slump requirements do not apply.

## PART 2 PRODUCTS

### 2.1 CONCRETE INGREDIENTS

Concrete shall conform to ASTM C 94; type optional.

### 2.2 CURING MATERIALS

Curing materials shall be burlap, impervious sheets, or membrane-forming compounds.

### 2.3 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel.

### 2.4 FORM MATERIALS

Forms for concrete surfaces shall be metal, plywood, or hardboard capable of producing the required surface without adverse effect on the concrete. Form coating shall be nonstaining form oil or form release agent that will not adversely affect the concrete surfaces or impair subsequent applications to the concrete. Form ties shall be metal, factory-fabricated, removable or

snap-off type that will not leave holes less than 6 mm (1/4 inch) nor more than 25 mm (1 inch) deep and not more than 25 mm (1 inch) in diameter.

## 2.5 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of fifty-five percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogenous material sufficiently porous to provide a good bond with portland paste; or factory-graded emery material consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The material shall be well graded from particles retained on the 0.600 mm (No. 30) sieve to particles passing the 2.36 mm (No. 8) sieve.

## 2.7 REINFORCEMENT

Bar reinforcement shall be deformed, Grade 60 billet steel conforming to ASTM A 615. Mesh reinforcement shall be welded steel wire fabric with wires at right angles to each other.

## 2.8 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 0.152 mm (6 mils) or other equivalent material having a vapor permeance rating not exceeding 28.6 nanograms per Pascal per second per square meter (0.5 perms).

## 2.9 WATER

Water shall be potable.

## PART 3 EXECUTION

### 3.1 PREPARATION OF SURFACES

Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance. Surfaces shall be moist but without free water when the concrete is placed.

### 3.2 FORMWORK

Formwork shall be mortar-tight, properly aligned, and adequately supported to produce concrete conforming accurately to the indicated shapes, lines, dimensions, and with surfaces free of offsets, waviness, or bulges. Where surfaces are to be exposed or painted, panels shall be of uniform sizes, using smaller panels only where required by openings, joints or for closure. Unless otherwise shown, exposed external corners shall be chamfered, beveled or rounded by moldings placed in the forms. Form surfaces shall be thoroughly cleaned and coated before each use. Forms shall be removed at a time and in a manner that will not injure the concrete.

### 3.3 INSTALLATION OF REINFORCEMENT

Reinforcement shall be fabricated to the required shapes. Reinforcement shall be interrupted 50 mm (2 inches) on each side of expansion joints. Reinforcement shall be accurately positioned and secured in place.

### 3.5 INSTALLATION OF VAPOR BARRIER

Unless otherwise indicated, subgrades for slabs in buildings shall be covered with a vapor barrier. Vapor barrier edges shall be lapped at least 100 mm (4 inches) and ends shall be lapped not less than 150 mm (6 inches). Patches and

lapped joints shall be sealed with pressure-sensitive adhesive or tape not less than 50 mm (2 inches) wide and compatible with the membrane.

### 3.6 INSTALLATION OF EMBEDDED ITEMS

Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.

### 3.7 BATCHING, MIXING AND TRANSPORTING CONCRETE

The work shall conform to ACI 318/318R part Construction Requirements, except as otherwise specified.

### 3.8 CONCRETE PLACEMENT

Concrete shall be handled from mixer 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. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 2.4 meters (8 feet) 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 (12 inches) thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level to avoid excessive shimming or grouting.

### 3.9 CONSOLIDATION

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 100 mm (4 inches) or less. 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 8000 vibrations per minute, and the head diameter and amplitude shall be appropriate for 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 few millimeters (inches). The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm (6 inches) into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 100 mm (4 inches) and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

### 3.10 WEATHER LIMITATIONS

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 temperature of the concrete placed during warm weather shall not exceed 30 degrees C (85 degrees F) 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 (95 degrees F).

### 3.11 CONSTRUCTION JOINTS

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.

### 3.12 FINISHING CONCRETE

#### 3.12.1 Formed Surfaces

Fins and loose material shall be removed. Unsound concrete, voids over 13 mm (1/2 inch) in diameter, and tie-rod bolt holes shall be cut back to solid concrete, reamed, brush-coated with cement grout, and filled solid with a stiff portland cement and sand mortar mix. Patchwork shall finish flush with adjoining concrete surfaces in texture and color. Patchwork shall be cured for 72 hours.

#### 3.12.2 Unformed Surfaces

##### 3.12.2.1 Rough-Slab Finish

Slabs to receive fill or mortar setting beds shall be screeded with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.

##### 3.12.2.2 Float Finish

Slabs to receive a steel trowel finish and slabs, where indicated, shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated. Lightweight concrete or concrete that portrays stickiness shall be finished with a magnesium float in lieu of a wood float, and left free of ridges and other projections.

##### 3.12.2.3 Trowel Finish

Slabs, where indicated, shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs 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. A final hard steel troweling shall be done by hand.

##### 3.12.2.4 Broom Finish

After floating, slabs, where indicated, shall be lightly trowelled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

### 3.13 CURING AND PROTECTION

#### 3.13.1 General

Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 10 degrees C (50 degrees F) for the first 3 days and at a temperature above 0 degrees C (32 degrees F) for the remainder of the specified curing period.

### 3.13.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 50 mm (2 inch) minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap or saturated burlap.

### 3.13.3 Membrane Curing

Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete; except a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements may be used for surfaces which 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, roofing, waterproofing or flooring specified. 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. Surfaces shall be thoroughly moistened with water and the 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. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions. 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. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period. 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.

## 3.14 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, 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. (3/4 inch.) 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.

## 3.15 REPAIR OF CONCRETE CRACKS

For repair of concrete with cracks, refer to Specification 02760, FIELD MOLDED SEALANTS FOR SEALING JOINTS AND CRACKS IN RIGID PAVEMENT AND CONTAINMENT BASIN.

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) Designation System for Aluminum Finishes

AA SAA-46 (1978) Standards for Anodized Architectural Aluminum

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (1992) Ladders - Fixed - Safety Requirements

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1993a) Structural Steel

ASTM A 53 (1993) 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 446 (1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

ASTM A 525 (1993) General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

## FEDERAL SPECIFICATIONS (FS)

FS RR-G-1602 (Rev C) Grating, Metal, Other Than Bar Type (Floor, Except for Naval Vessels)

FS RR-C-271 (Rev D) Chain and Attachments, Welded and Weldless

## NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM-01 (1988) Metal Finishes Manual for Architectural and Metal Products

## 1.2 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 446, or ASTM A 525, 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.

### 1.3 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: SUBMITTALS:

#### Drawings

Miscellaneous Metal Items; GA.

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:

- a. Floor Grating.
- b. Vertical Access Ladders.

### 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.

## PART 2 PRODUCTS

## 2.1 FLOOR GRATINGS AND FRAMES

Steel grating on walkway surfaces and stair treads shall be designed in accordance with NAAMM-01 for bar type floor gratings and FS RR-G-1602 for floor gratings other than bar types to meet the indicated load requirements. Edges shall be banded with bars 6 mm less in height than bearing bars for grating sizes above 20 mm inch. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Floor gratings, supporting frames and all stair treads shall be galvanized after fabrication.

## 2.2 LADDERS

Ladders shall be fabricated from A36 steel, fixed fail type in accordance with ANSI A14.3. Rungs are to be fabricated from 16mm diameter rebar, Grade 60. Ladders shall be galvanized after fabrication.

## 2.3 SAFETY CHAINS

Safety chains shall be galvanized welded steel, proof coil chain in accordance with FS RR-C-271, Type I, Class 4. Safety chains shall be straight link style, 5 mm diameter, minimum 39 links per meter and with bolt type snap hooks on each end. Eye bolts for attachment of chains shall be galvanized 10 mm bolt with 20 mm eye, anchored as indicated. Two chains shall be furnished for each guarded opening.

## 2.4 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.

## 2.5 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, yellow finish unless otherwise indicated.

## 2.6 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.

## 2.7 TRENCH COVERS, FRAMES, AND LINERS

Trench frames and anchors shall be all welded steel construction designed to match cover. Covers shall be secured to frame and shall be cast-iron grating. Grating opening widths shall not exceed 25 mm. Trench liners shall be cast iron with integral frame for cover.

## PART 3 EXECUTION

### 3.1 GENERAL 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 PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of concrete and the hollow cores of the pipe filled with concrete.

### 3.3 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

### 3.4 MOUNTING OF SAFETY CHAINS

Safety chains shall be mounted 1 meter and 0.6 meters above the floor.

END OF SECTION

SECTION 08520  
ALUMINUM WINDOWS

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (1988) Voluntary Specifications for Aluminum Prime Windows and Sliding Glass Doors

AAMA 1503.1 (1988) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991) Flat Glass

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Specified Pressure Doors Under Differences Across the Specimen

ASTM E 330 (1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

ASTM E 547 (1986) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

ASTM E 773 (1988) Seal Durability of Sealed Insulating Glass Units

ASTM E 774 (1988) Sealed Insulating Glass Units

1.2 WINDOW PERFORMANCE

Aluminum windows shall be designed to meet the following performance requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no glass breakage, permanent damage to fasteners, hardware

parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

#### 1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

#### 1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 547.

### 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 SUBMITTALS:

#### Data

Aluminum Windows; FIO.

Manufacturer's descriptive data and catalog cut sheets.

#### Drawings

Aluminum Windows; FIO.

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment.

#### Instructions

Aluminum Windows; FIO.

Manufacturer's preprinted installation instructions and cleaning instructions.

#### Certificates

Aluminum Windows; FIO.

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates.

### 1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

#### 1.5 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

### PART 2 PRODUCTS

#### 2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glass, frame, weatherstripping, and hardware. Windows shall conform to AAMA 101. Windows shall be double-glazed and shall have a minimum condensation resistance factor of 50 when tested in accordance with AAMA 1503.1.

##### 2.1.1 Horizontal-Sliding Windows

Aluminum horizontal windows shall conform to AAMA 101 HS-C20 type consisting of sliding sash and fixed lite. Sash guides shall be nylon wheels.

#### 2.2 ACCESSORIES

##### 2.2.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, non-magnetic stainless steel, cadmium-plated steel, nickel/chrome-plated steel or magnetic stainless steel in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 1/16 inch.

##### 2.2.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel of quality established by AAMA 101.

##### 2.2.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

#### 2.3 GLASS AND GLAZING

Aluminum windows shall be designed for inside glazing, field glazing, and for glass types scheduled on drawings. Units shall be complete with glass and glazing provisions to meet AAMA 101. Glazing material shall be compatible with aluminum, and shall not require painting.

##### 2.3.1 Insulating Glass

Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by 1/2 inch aluminum spacer and dehydrated space conforming to ASTM E 773 and ASTM E 774. Aluminum spacer shall be roll-formed, with bent or tightly solder joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone. Glass types shall be as follows:

### 2.3.2 Clear Insulating Glass

Glass for two-pane insulating units shall be Type I annealed glass, Class 1 - clear, Quality q3 - glazing select, 1/8-inch thick glass conforming to ASTM C 1036.

## 2.4 FINISH

### 2.4.1 Anodized Aluminum Finish

Exposed surfaces of aluminum windows shall be finished with anodic coating conforming to AA DAF-45: Architectural Class II, AA-M10-C22-A31, clear anodic coating, 0.4 to 0.7 mil thick, 204-R1 Natural Color. Finish shall be free of scratches and other blemishes.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA 101. The completed window installation shall be watertight.

### 3.2 ADJUSTMENTS AND CLEANING

#### 3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

#### 3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

END OF SECTION

SECTION 08700  
BUILDERS' HARDWARE

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 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA-01 (Effective thru Jun 1993) Directory of Certified Locks & Latches

BHMA-02 (Effective thru Jul 1993) Directory of Certified Door Closers

BHMA A156.1 (1988) Butts and Hinges

BHMA A156.2 (1989) Bored and Preassembled Locks and Latches

BHMA A156.4 (1986) Door Controls - Closers

BHMA A156.6 (1986) Architectural Door Trim

BHMA A156.7 (1988) Template Hinge Dimensions

BHMA A156.21 (1989) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI-02 (1986) Installation Guide for Doors and Hardware

DHI-03 (1989) Keying Systems and Nomenclature

DHI-04 (1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames

DHI-05 (1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

FEDERAL STANDARDS (FED-STD)

DACA67-99-B-0010

08700-1

FED-STD 795

(Basic) Uniform Federal Accessibility Standards

## 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 SUBMITTALS:

### Data

Hardware and Accessories; FIO.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, closers, after approval of the detail drawings, and not later than 1 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.

### Schedules

Hardware Schedule; FIO.

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying Schedule; GA.

Keying schedule developed in accordance with DHI-03, after the keying meeting with the user.

### Certificates

Hardware and Accessories; FIO.

The material supplier's or hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of materialsupplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA-01 and BHMA-02 directories of certified products may be submitted in lieu of certificates. A separate Certificate of Compliance attesting that hardware items conform to the "Buy American Act" shall be included.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

#### 1.4 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, spanner and socket wrenches, and dogging keys, shall be provided as required to adjust hardware items.

### PART 2 PRODUCTS

#### 2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings. Hardware items providing accessibility and usability for physically handicapped shall comply with FED-STD 795.

#### 2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA A156.7.

#### 2.3 HINGES

Hinges shall conform to BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

#### 2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. Lock and latch set trim handles shall be of a simple design in accordance with manufacturer's standard practice. Knob diameter shall be 2-1/8 to 2-1/4 inches.

##### 2.4.1 Bored Lock and Latchsets

Bored lock, latchsets, and strikes shall be series 4000 and shall conform to BHMA A156.2, Grade 1. Bored type locks and latches for doors 1-3/8 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

##### 2.4.2 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA A156.5. Lock cylinder shall have not less than six pins.

##### 2.4.3 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA A156.2 or BHMA A156.13, knobs, roses, and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that knob shanks shall be 0.060 inch thick.

#### 2.5 KEYING

Locks shall be keyed in sets or subsets as scheduled. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks: 2 change keys each lock.

The keys shall be furnished to the Contracting Officer arranged for key control system storage in sets or subsets as scheduled.

## 2.6 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified.

### 2.6.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Standard Cover. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position.

## 2.7 MISCELLANEOUS

### 2.8.1 Metal Thresholds

Threshold shall conform to BHMA A156.21. Threshold for exterior door shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weatherstripping. Threshold for door accessible to the handicapped shall be beveled with slopes not exceeding 1:2 and with heights not exceeding 1/2 inch. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

### 2.8.2 Rain Drips

Extruded aluminum, not less than 1.78 mm (.07 inch) thick, clear anodized. Overhead rain drops shall be approximately 38 mm (1-1/2 inches) high by 63 mm (2-1/2 inches) projection and shall extend 50 mm (2 inches) on either side of the door opening width.

### 2.8.3 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be clear (natural) anodized. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

## 2.9 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware.

## 2.10 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA A156.18

## PART 3 EXECUTION

## 3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI-05. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI-02 or.

## 3.1.1 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

## 3.1.2 Thresholds

Thresholds shall be secured with a minimum of 3 fasteners per single door width and 6 fasteners per double door width with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4-inch thread engagement into the floor or anchoring device used.

## 3.1.3 Rain Drips

Overhead rain drips shall align with bottom edge of door frame rabbet. Drips shall be set in sealant and fastened with stainless steel screws.

## 3.1.4 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

## 3.2 HARDWARE SETS

HW-1	1-1/2	PR	Butts A5112
	1	EA	Lockset F83 Grade 1 with lever handle
	1	EA	Closer/stop CO1511 ADA Compliant
	1	EA	Threshold, J12100 ADA Compliant
	1	SET	Weatherseal Sim to Pemko S88W17
	1	EA	Door Sweep Sim to Pemko 314CN
HW-2	1-1/2	PR	Butts A5112
	1	EA	Lockset F76 Grade 1 with lever handle
	1	EA	Doorstop, L02251
HW-3	1-1/2	PR	Butts A5112 NRP
	1	EA	Lockset, F86 - Grade 1 with lever handle
	1	EA	Doorstop, L01371
	1	SET	Weatherseal Sim to Pemko S88W17
	1	EA	Threshold J12100 ADA Compliant
	1	EA	Doorsweep Sim to Pemko 307AV
	1	EA	Closer C02041 ADA Compliant
HW-4	3	PR	Butts A5112 NRP
	1	EA	Lever Extension Flush L04081 (inactive leaf)

1	EA	Lockset F86 Grade 1 with lever handle
2	EA	Doorstop L01371
1	SET	Weatherseal Sim to Pemko S88W20
1	EA	Threshold J12100 ADA Compliant
2	EA	Doorsweep Sim to Pemko 307AV
1	EA	Closer C02041 ADA Compliant (Active leaf)

END OF SECTION

SECTION 09250  
GYPSUM WALLBOARD

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 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 475	(1989) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 630	(1990) Water-Resistant Gypsum Backing Board
ASTM C 754	(1988) Installation of Steel Framing Members to Receive Screw-Attached Gypsum
ASTM C 840	(1988) Application and Finishing of Gypsum Board
ASTM C 955	(1988) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases
ASTM C 1002	(1988) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
ASTM C 1047	(1985; R 1990) Accessories for Gypsum Wallboard and Gypsum Veneer Base

1.3 DESIGN REQUIREMENTS

Except where otherwise indicated or specified, the work shall conform to and shall be applied as indicated in the finish schedule.

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 SUBMITTALS:

Certificates

Gypsum Wallboard; FIO. Water-Resistant Gypsum Board; FIO.

Certificates shall state that the steel framing and wallboard meet the specified requirements.

## 1.5 DELIVERY AND STORAGE

Wallboard delivered prior to use shall be stored off the ground within a completely enclosed structure or completely enclosed within a weathertight covering. Wallboard shall be dry, free of warpage, and have bundling tape intact immediately prior to use. Application shall commence only after the structure is completely weathertight.

## PART 2 MATERIALS

### 2.1 MATERIALS

Materials shall conform to the requirements specified below. Miscellaneous items not otherwise specified shall be as recommended by the wallboard manufacturer and approved prior to use. The long edges of wallboard shall be tapered, except when used as a base layer in a double layer application. Power driven fasteners may be used only when approved in writing. Thickness of wallboard shall comply with the systems, as detailed on the drawings.

#### 2.1.1 Steel Framing, Furring, and Related Items

ASTM C 955.

#### 2.1.2 Vapor Retarder

Foil-backed gypsum board or 4-mil polyethylene.

#### 2.1.3 Water-Resistant Gypsum Board

ASTM C 630; surface shall be paintable; regular, or Type X (Special Fire-Resistant), as required; 48-inches wide.

#### 2.1.5 Joint Treatment Materials

ASTM C 475.

##### 2.1.5.1 Taping or Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum wallboard joints and fastener heads and completely compatible with tape and substrate.

##### 2.1.5.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

##### 2.1.5.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape and substrate.

##### 2.1.5.4 Joint Tape

Reinforcing tape recommended by the manufacturer.

#### 2.1.6 Nails

ASTM C 514.

### 2.1.7 Screws

ASTM C 1002, Type S for attachment to light-gauge steel members.

### 2.1.8 ACCESSORIES

ASTM C 1047, Cornerbeads, edge trim, and control (expansion) joints shall be corrosion protective-coated steel designed for the intended use. Flanges shall be free of dirt, grease, and other materials that may adversely affect the bond of joint treatment.

## PART 3 EXECUTION

### 3.1 STEEL FRAMING

Installation of steel framing shall conform to ASTM C 754, except that limiting heights shall be according to manufacturer's current published data. Framing shall be spaced as detailed on the drawings with a maximum of 24 inches on center.

#### 3.1.1 Partition Framing System

Metal framing and furring system shall be capable of carrying a transverse load of 5 psf without exceeding either the allowable stress or a deflection of  $L/240$ .

#### 3.1.2 Ceiling Openings

Support members shall be provided at ceiling openings such as required for recessed light fixtures, and for air supply or exhaust. Support members of not less than 1-1/2 inch main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members, although not a part of the structural system, shall be provided for attachment or suspension of support members.

#### 3.1.3 Wall Openings

For wall openings such as required for doors, pass-through openings, and access panels, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Partitions abutting continuous suspended ceilings shall be strengthened for rigidity at rough openings, such as door openings, of more than 30-inches wide. Studs at openings shall be 20 gauge minimum bare metal thickness and spot grouted at jamb anchor inserts. Double studs shall be fastened together and secured to floor and overhead runners with screws.

### 3.2 APPLICATION OF GYPSUM WALLBOARD

Gypsum wallboard shall be applied to framing and furring members in accordance with ASTM C 840 and the requirements specified herein except when fire-resistant assemblies are required. Gypsum wallboard shall be applied with separate boards in moderate contact without forcing in place. End joints of adjoining boards shall be staggered. Abutting end and edge joints shall be neatly fitted. Use gypsum wallboard of maximum practical length. Gypsum wallboard shall be cut as required to make neat close joints around openings. In vertical application of gypsum wallboard, panels shall be of length required to reach full height of vertical surfaces in one continuous piece. Surfaces of gypsum wallboard and substrate members may be adhered together with an adhesive, except adhesive shall not be used in lieu of fasteners for

fire-rated assemblies. In single-ply installations and the first layer in a multi-ply installation, all ends of gypsum wallboard shall occur over framing members or other solid backing except where treated joints occur at right angles to framing or furring members. Casing beads shall be provided at the edges of gypsum wallboard abutting dissimilar surfaces.

### 3.3 VAPOR RETARDER

Vapor retarder shall be installed with joints over framing members. Joints shall be lapped for the full width of the framing members. Foil-backed wallboard may be used in lieu of a separate vapor retarder sheet, in which case the reflective surface of the foil-backed wallboard shall be placed against the face of the framing members.

### 3.4 FINISHING OF GYPSUM WALLBOARD

Gypsum wallboard shall be taped and finished in accordance with ASTM C 840. Joint, fastener depression, and corner treatment shall be provided.

### 3.5 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum wallboard smooth, uniform in appearance, and ready to receive finish as specified.

END OF SECTION

## SECTION 09873

INTERIOR TANK COATING FOR  
STEEL STORAGE TANKS

## 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 881 (1990) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

ASTM D 149 (1992) Dielectric Breakdown Voltage Testing

ASTM D 638 (1990) Standard Test Method for Tensile Properties of Plastics

ASTM D 4541 (1985) Tensile Adhesion by Portable Adhesion Testers

## CODE OF FEDERAL REGULATIONS (CFR)

CFR 29 Part 1910 (1993) Occupational Safety and Health Administration (OSHA) Requirements

## NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0188 (1990) Discontinuity (Holiday) Testing of Protective Coatings

## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 6 (1991) Commercial Blast Cleaning

SSPC SP 5 (1991) White Metal Blast Cleaning

SSPC PA 2 (1991) Measurement of Dry Paint Thickness with Magnetic Gages

SSPC VIS 1 (1989) Visual Standard for Abrasive Blast Cleaned Steel

## U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1 Safety and Health Requirements Manual  
October 1992

## 1.2 SAFETY

All work shall be accomplished in accordance with the requirements of the US Army Corps of Engineers safety manual, EM 385-1-1, "SAFETY AND HEALTH REQUIREMENTS MANUAL", and as specified herein.

## 1.2.3 Government Inspector Equipment and Training

The Contractor shall provide all equipment necessary for Government inspector.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

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following shall be submitted in accordance with Section 01300 SUBMITTALS:  
DATA

Coating Components Data; GA.

Manufacturer's and formulator's data shall be submitted at least two weeks prior to the start of work giving the brand names, catalog numbers and generic formulation of epoxy filler and all coating system components including primer. The submittal shall include certified copies of laboratory test reports which verify compliance with all requirements specified herein. Certified copies of the certificate of analysis and the Chemical Abstract Service number for each manufacturer's batch of epoxy coating system components shall be submitted at least two weeks prior to use of the material in the work. Data shall be in sufficient detail to demonstrate compliance with contract requirements.

#### INSTRUCTIONS

Manufacturer's Instructions; FIO.

The coating material manufacturer's instructions and recommended procedures for all work including batching, mixing, conveying (including pumping and spraying), application, curing, and testing at least two weeks prior to the start of work, and including:

a. A list of equipment to be used in the work including detailed mixing, conveying, and application equipment requirements and procedures, manufacture, model number, special features and quantities of equipment required to complete the work as scheduled.

b. Detailed sampling and testing equipment requirements and procedures.

c. Detailed application procedures to include maximum and minimum times between the application of coats.

d. Detailed curing procedures.

e. Material safety data sheets (MSDS) in accordance with CFR 29 Part 1910 section 1200 Hazard Communication and Section: 01950, MANAGEMENT PLAN.

f. Material storage requirements, range of temperatures, etc.

#### SCHEDULES

Work Schedule; GA.

A Work Plan shall be submitted and shall be reviewed and if changes are necessary during progress of the work a request for change shall be submitted to the CO for approval as soon as the need for change becomes evident.

#### STATEMENTS

Coating Manufacturer's Technical Representative; GA.

A letter, at least two weeks prior to the start of work, listing the experience and training of the Epoxy Coating Manufacturer's Technical Representative/Representatives [see paragraph On Site Manufacturer's Technical Representative (MTR)], and shall include the name, phone number and address of the MTR. The letter shall include a statement from the coating manufacturer certifying that the MTR is not an employee of the Contractor and that the MTR meets all of the qualification requirements of paragraph "On Site Manufacturer's Technical Representative" of this Section.

Testing Laboratory; GA.

A letter, at least two weeks prior to the start of work, listing the qualifications of the proposed independent testing laboratory(s) to be

utilized to evaluate samples, and perform field testing.

Testing and Safety Equipment; FIO.

Complete and detailed written Procedures shall be submitted and approved, detailing the procedures and regulations to be followed for all aspects of the work.

The following shall be provided as part of the management plan:

- a. A listing of proposed testing equipment, complete with calibration records, to be used for inspections and tests.
- b. A listing of all personnel safety equipment to be utilized in the work.

#### Reports

Coating Test Sections and Applicator Certification; FIO.

A report, no more than one week after completion of all testing of the coating and applicator test sections, detailing the location of the test sections, the equipment and methods used to prepare and test them, the results of all tests performed and the name of the coating applicator.

Material Testing; GA.

At least 3 certified copies of the Material Testing results, not more than 48 hours after the completion of the Material Testing. The results of the testing of each sample shall be dated and certified by the signature of the testing laboratory's technical representative. The certification shall state if the interpretation of the testing laboratory's results prove the sample to be in compliance with these specifications.

Inspections and Tests; GA. Blast Cleaning Inspections; GA. Initial Inspection; GA. Follow-up Inspection; GA. Viscosity Tests; GA. Final Inspection; GA.

At least 3 copies of the results of inspections and tests, not more than 48 hours after the completion of the inspection and tests, and shall be supplied in booklet form. A separate section shall be included for each inspection or test. Each section shall contain a detailed description of the inspection and include as a minimum each of the items listed below. Results shall be dated, certified, and signed by the MTR. The MTR certification shall state that required procedures were accomplished, that the procedures were conducted in compliance with the plans and specifications, and that safety requirements were complied with. At least 3 copies of each individual inspection or test report shall be submitted within 48 hours after the completion of that inspection or test.

- a. A list of all equipment used, with calibration certifications.
- b. A copy of all measurements taken.
- c. The date of inspection/test.
- d. The parameters to be verified.
- e. The condition specified for the parameter.
- f. The inspection/test results.
- g. A description of all adjustments made.

#### SAMPLES

Material Samples; FIO.

A one-quart sample of each batch of each component and mixtures of components of the initial coat, intermediate coat, finish coat, epoxy filler and all

other surface repair materials. Each sample shall be submitted during the work shift in which the sample was collected.

#### OPERATION AND MAINTENANCE

Maintenance Manual; GA.

At least 2 complete reproducible copies of the maintenance manual, at least one week prior to the completion of the Final Inspection for the 1st tank. The manual shall include:

(1) Description of routine tests and inspections required, including recommendations as to how often tests and inspections should be performed.

(2) Premature failure conditions with possible causes and remedies for each.

(3) Maintenance/re-coating procedures to include surface preparation.

#### 1.4 QUALIFICATIONS

##### 1.4.1 Licensing Requirements

The Contractor shall meet the licensing requirements of Washington State.

##### 1.4.2 On Site Manufacturer's Technical Representative (MTR)

The Contractor shall be responsible for providing the services of a technical representative, or team of representatives, of the epoxy coating manufacturer.

NOTE: MTR, as used herein, shall be understood to refer to either the manufacturer's technical representative or a group of individuals with the collective technical experience who represent the epoxy coating manufacturer.

The MTR shall not be an employee of the Contractor. The MTR shall be on site full time during initial project start up until completion of the first steel tank repair, lining and testing work and present at all coating testing procedures per ASTM D4541, D149 and NACE RP0188. The MTR shall advise on surface preparation, inspections, surface repair materials and methods, all aspects regarding material handling, batching and mixing, application, curing, and testing. The MTR shall advise the Contractor, and the Contracting Officer directly on all aspects of the work. The MTR shall have successfully completed all of the manufacturer's or formulator's training for tank cleaning, material storage, mixing, application, and testing. The MTR shall have been directly involved in surface preparation, evaluation and application of tank coatings for not less than 10 steel fuel storage tanks within the last 5 years.

##### 1.4.3 Coating Applicator and Quality Control Personnel Certification:

1.4.3.1 Coating applicator(s) shall be experienced in application of epoxy coating systems similar or equal to that specified to be applied. Certification of all coating applicators is required for each type of spray gun application which will be used. Each coating applicator shall apply the complete coating system specified on a 6-foot by 6-foot square test section as specified in paragraph COATING TEST SECTIONS. In preparation, Contractor shall clean the steel as specified. The coating system to be applied shall be Contractor supplied and be previously tested and approved as specified. The Certification of the coating applicator is dependent on the test section passing all aspects of the coating application, including curing and testing as specified in paragraph COATING TEST SECTIONS. The coating applicator shall not apply any coating on the items to be coated in this contract until he has been certified. The CO reserves the right to require recertification of any coating applicator. The CO and the coating manufacturers on site technical representative (MTR) shall be in attendance during certification of coating applicators. The applicator being tested shall prepare the materials to be

used in the test as specified as part of the certification testing. The test panels, to be used in the certification tests, may be cleaned steel tank surfaces as specified in paragraph COATING TEST SECTIONS, or a mockup of the interior tank surface as approved by the CO. All costs for coating certification or recertification testing shall be at no additional cost to the Government. Deficiencies in the coating, improper mixing, or improper application methods are basis for failure. Contractor quality control personnel shall observe the mixing, preparation, and application of coatings and shall check the adequacy of the coating system on the test sections.

1.4.3.2 The Contractor's quality control personnel shall be experienced in epoxy coating inspection of the specified coating material and methods of applications proposed. The Contractor shall present to the CO credentials of each quality control person that will be inspecting the work showing the individual is experienced in inspection techniques. The quality control person in-charge shall be certified by the National Association of Corrosion Engineers (NACE) as a paint inspector. No work specified herein shall commence unless the NACE certified paint inspector is on site full time. Each quality control person shall have had training and experience in inspection of the specified coatings. The quality control personnel shall observe and inspect the coating applicator certification noted above.

## 1.5 REGULATORY REQUIREMENTS

### 1.5.1 Conformance to Codes and Standards

Where equipment or material is specified to conform to requirements of a code or standard, such as UL, ASTM, NFPA, or NEMA, the design, fabrication and installation shall conform to that code or standard.

### 1.5.2 Disposal Regulations

The Contractor shall totally remove and be responsible for the disposal of waste, abrasive, etc.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Proper protection of products, before, during, and after installation is the Contractor's responsibility. Items shall be shipped and stored in conditions that comply with the manufacturer's recommendations.

## 1.7 FIELD MEASUREMENTS

The Contractor shall visit the job site and verify details of the work, to the extent possible, prior to the start of work. The Contractor shall immediately bring any contractual discrepancies or deficiencies discovered during this visit to the attention of the CO.

## 1.8 EQUIPMENT AND METHODS

All equipment used in the cleaning, surface repair, coating, and testing for the tank coating work specified herein shall be commercial manufactured equipment, as recommended by the coating manufacturer, shall be clean and in good operating condition, shall be suitable for the intended application, and shall be subject to approval. All equipment shall be free of remnants of old materials and contaminants, and shall be maintained in clean and good operating condition during the work for this project. The coating pumps and spraying system shall be a multi-component pump and sprayer which will accurately deliver properly proportioned and mixed material. The system shall be capable of delivering the coating mixture, to the surface being coated, within the manufacturer's recommended temperature range. The coating temperature shall be verified by taking temperature measurements on samples of the coating taken near the surface being coated. The system shall be capable of batching and mixing the coating components within an accuracy of +/- 2 percent of the manufacturer's recommended mix proportions. The sprayer and method of spraying shall be capable of ensuring a uniform application of the coating for each pass of the sprayer. The equipment shall be designed and operated to prevent entrainment and entrapment of air and foreign material,

and prevent contamination of the coating by foreign materials, and other contaminants. The systems material intakes shall be maintained fully submerged at all times during material pumping and spraying operations, if pumps start to draw air or cavitate the sprayer will be shut off and all material in the system shall be wasted outside of the tanks. The system shall be designed to provide thorough and complete mixing of the coating components.

The sprayer shall be equipped with removable/replaceable sprayer tip nozzles, the nozzles shall be inspected during each shift of coating application and maintained in a clean like new condition, and shall be replaced if it becomes clogged or fails to provide a uniform spray distribution of the coating. All compressed air supplies used in the work shall be clean dry air free of oil, moisture, and other contaminants. Compressed air used in the work shall be tested at the start of each shift and at least once per hour of compressor operations for the presence of oil and moisture by holding a piece of white paper a few feet in front of the air nozzle (other supply systems shall be turned completely off during this test). The compressed air supply shall have inline oil and moisture traps and filter, the traps and filters shall be inspected and cleaned at the beginning of each shift, during the shift, and when ever testing indicates oil or moisture in the air supply. Temperature monitoring instruments shall be standard manufactured equipment commonly used in the industry and shall be capable of accurately and reliably reporting the temperature conditions. The Contractor shall monitor the temperature of each epoxy coating material component, the mixed epoxy coating material at the discharge nozzle, and at other locations as recommended by the coating manufacturer. The Contractor shall monitor the air and steel surface temperature conditions during coating application as specified in paragraph APPLICATION OF COATING.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Products used shall be resistant to Mogas, Diesel, No. 2 Oil, No. 4 Oil, JP-4, JP-5, JP-7, and JP-8. Zinc, copper, and alloys that contain zinc or copper shall not be used where they will come into contact with JP-4, JP-5, JP-7, or JP-8 including pipe, valves, equipment, and accessories.

### 2.2 EPOXY COATING

The epoxy coating material shall be a 100 percent solids two component novolac epoxy, moisture insensitive, chemically resistant, suitable for the intended application, and shall conform to the requirements specified herein and to the manufacturer's specific recommendations for this project, and shall be subject to approval. The epoxy coating material shall be furnished with a certificate of analysis substantiating that at least 65 percent of the part "A" epoxy component is a true novolac epoxy by weight, which when combined with component B will produce an epoxy coating having an average functionality of at least 2.4 cross-link sites per unit volume. The certificate of analysis shall be furnished with a letter of compliance citing the Chemical Abstract Service (CAS) number certifying compliance with the specified requirements. The epoxy coating material shall conform to ASTM C-881, Type I, III, or IV and shall have a low to medium viscosity, and shall conform to the physical requirements of Table 1 of ASTM C-881, except as otherwise specified herein. The grade and class shall be selected as appropriate for the application, and subject to approval. The epoxy coating material shall provide a mixed viscosity which will thoroughly wet the contact surfaces and allow maximum bond strength development of each coating layer application. In addition the cured epoxy coating shall be resistant to 0.2 Percent Diethylene Glycol Monomethylether over a lifetime of continuous contact. The epoxy coating shall have a high bond strength to ensure that the coating will not fail in bond to the surfaces being coated. The epoxy coating shall conform to the requirements specified herein, except that it shall have a tensile strength of at least 3,600 psi as determined by ASTM D-638. The tensile elongation shall conform to the manufacturer's recommendation for tank coatings in steel tanks, suitable for bridging cracks and joints/weld seams in the steel tanks, but shall not be less than the requirements of ASTM C 881. The linear coefficient of shrinkage shall conform to the manufacturer's recommendations, shall be

suitable for the intended application, and shall be subject to approval. The linear coefficient of shrinkage shall be selected to provide a cured in place coating which is free of cracks, reduced coating thickness, or other deficiencies. The requirements of ASTM C 881, paragraph 6, for the A component, shall be changed to replace the requirement for "bisphenol-A" with "bisphenol-A and/or phenol formaldehyde," and the requirement added to the paragraph that the A component shall be 65 percent true novolac epoxy by weight. The coating manufacturer shall be responsible for verifying all chemical constituents of the fuels to be stored in the tanks (see paragraph 2.1 MATERIALS), and shall provide a statement certifying that the coating is compatible with the fuels, and that the material properties (specifically including tensile elongation and chemical compatibility) are suitable for the intended application. The Contractor shall submit with his DATA submittal the coating manufacturer's statement(s) certifying the compatibility and suitability of their product. The epoxy coating material shall be formulated to provide alternate light and dark colors, with shades as specified herein to aid in readily discerning between coating layers. The color of the final coat of the cured epoxy coating shall be white or the manufacturer's lightest color. The manufacturer shall also provide documentation confirming that the proposed epoxy coating material has performed successfully as a lining material for steel fuel storage tanks which have been in service for at least 3 years prior to the date of this construction solicitation.

Note: All material containers delivered to the site shall be in like new condition, and shall be free of dents or other types of damage. All of the containers shall have the manufacturers standard label identifying the material in the container, the label shall contain detail information regarding the contents, i.e. product name, component (A or B, etc.), batch number, date batched, and all hazard information, and instruction for safe handling and storage. Any container at the site which does not have a complete and legible label shall be marked with a highly visible permanent marker indicating "reject" and shall be immediately removed from Government property. Containers and their contents which fail to meet all specified requirements are specifically prohibited from use in the work, and specifically prohibited from being brought on to or stored on Government property.

### PART 3 EXECUTION

#### 3.1 GENERAL

An initial visual inspection shall be performed within each tank following the initial cleaning. The inspection shall be completed in accordance with paragraph TANK CONDITION INSPECTION of this Section.

Prior to the start of abrasive blast cleaning the Contractor shall be responsible for the following:

a. Assuring that temporary plugs are provided for all lines connecting to the tanks. Plugs shall be secure and vapor tight to prevent fuel fumes from entering the tank from the lines and to prevent work generated contaminants from entering the lines.

b. Assuring that access ladders, pumps, interior plumbing not indicated to be coated, and other surfaces as directed are completely protected by securely attaching coverings, or by other methods as approved.

#### 3.2 ABRASIVE BLAST CLEANING

##### 3.2.1 General

All interior tank surfaces shall be cleaned by abrasive blast cleaning to remove surface contaminants. Care shall be taken to ensure that all interior tank surfaces including the concealed faces of the wall column stiffener plates, horizontal tee flanges and their gusset plates, and the splash trough are thoroughly blast cleaned. After abrasive blast cleaning, the tank surfaces shall be thoroughly cleaned. Disposal of blast cleaning residues

shall be the responsibility of the Contractor.

NOTE: Dry abrasive blast cleaning shall not begin until the surface temperature of the steel is at least 30 degrees C (5 degrees F) above the dew point temperature of the air within the tank and once begun this condition shall be maintained during the rest of the cleaning and coating process. If wet abrasive blast cleaning is to be used this requirement is not necessary; however, it is essential that inhibitors be added to the water or applied to the surface immediately after blast cleaning to temporarily prevent rust formation. It is essential that inhibitors be approved by the coating system manufacturer for use with the specified coating system. Paragraph APPLICATION OF COATING contains additional temperature control requirements specified for the coating process.

### 3.2.2 Initial Abrasive Blast Cleaning

Surfaces within a tank shall be cleaned in accordance with SSPC SP 6 to the "commercial" level in conformance with SSPC VIS 1. After the initial abrasive blast cleaning has been successfully completed, a surface standard shall be prepared as specified in Paragraph BLAST CLEANING INSPECTIONS.

### 3.2.3 Follow-up Abrasive Blast Cleaning

The follow-up abrasive blast cleaning shall begin within 24 hours of the successful completion of a follow-up inspection as specified in Paragraph BLAST CLEANING INSPECTIONS. All surfaces within a tank shall be cleaned in accordance with SSPC SP 5 to "white metal" in conformance with SSPC VIS 1. After completion of the follow-up cleaning of the tank interior, another follow-up inspection shall be performed.

## 3.3 BLAST CLEANING INSPECTIONS

### 3.3.1 Surface Standard

After initial blast cleaning of a tank is complete, a surface standard shall be prepared. The surface standard no less than one square foot in surface area shall be located in a convenient area within the tank. The surface standard shall be cleaned in accordance with SSPC SP 5 to white metal in conformance with SSPC VIS 1 and to develop the manufacturer's required surface profile. This surface standard shall be used as a standard of comparison throughout the course of the final blast cleaning work within the tank. The nozzle type and size, the air pressure, the size/type and hardness of the abrasive, the distance from nozzle to the panel, and the angle of blast used to prepare the standard shall be recorded. The profile of the surface standard before and after the white blast shall be determined with a comparative surface profile that is appropriate for the abrasive used; the anchor pattern shall be evaluated with a comparative Keane-Tator surface profile to ensure that it is useful. The prepared surface standard shall be covered and protected until completion of the cleaning within the tank.

### 3.3.2 Follow-up Inspection

A follow-up inspection shall be performed within each tank by the Contractor's Quality Control staff after each stage of blast cleaning within that tank. The tank shall be inspected to verify that all loose materials have been removed, that the facility is safe to continue work, and that all surfaces are free of compressor oil. A black light shall be used to check for fluorescence from compressor oil.

a. If loose material is found, it shall be removed and the inspection repeated.

b. If compressor oil is found, the compressor, hoses, etc., shall be replaced, the oil shall be removed and the inspection repeated.

## 3.4 TANK CONDITION INSPECTION

### 3.4.1 General

Tank condition inspections for steel tanks shall be performed by a NACE Certified Inspector. The visual inspection is performed after completion of abrasive blast cleaning. During this inspection the inspector shall mark suspect areas identified in the first visual inspection and identify new areas of interest that the abrasive blast cleaning has disclosed. During this inspection the inspector shall identify the type of testing to be performed at each location identified in the visual inspections. Documentation for the second visual inspection shall be the same as that required for the first visual inspection. Inspection and testing shall be as specified herein. The results of all test shall be documented.

### 3.5 MIXING OF COATING MATERIALS

The use of a mixer that creates a vortex or stirring motion shall not be used. "Boxing" the pouring of liquid back and forth from one can into another and back again is specifically prohibited. Otherwise, mixing shall be performed in accordance with the coating manufacturer's instructions.

### 3.6 COATING TEST SECTIONS

Prior to start of the coating application work for this project, the Contractor shall prepare a minimum of two coating test sections on the cleaned and prepared steel surface of the first steel tank to be coated. These test sections shall be a minimum of 2 m x 2 m (one on the wall and one on the floor) and shall demonstrate all aspects of the coating application, including curing and testing. The tests may be performed in conjunction with coating applicator certification (see Paragraph, Coating Applicator and Quality Control Personnel Certification.) The test sections shall be subject to testing as specified herein to verify that the coating complies with all specified requirements. If the test section fails to pass all requirements the coating shall be removed and the steel cleaned, and the test section rerun. After completion of the tests the test sections shall be removed to expose the clean steel surface as specified, and the tank prepared for coating application. Test to performed are as follows:

a. Adhesion Test. The Contractor shall perform tests on the completed coating immediately following curing to verify coating adhesion to the steel surface. The tests shall be performed in accordance with ASTM D 4541 at 3 locations on each test section as designated by the CO. The minimum acceptable value shall be 8.3 Mpa (1200 p.s.i.).

b. Dry Film Thickness Test and Pinhole Test as specified in Paragraph FINAL INSPECTION shall be made as directed by the CO to demonstrate coating compliance with the specified requirements.

### 3.7 SAMPLING AND TESTING

All sampling and testing for this project shall be the Contractor's responsibility, and shall be performed by an approved independent commercial testing laboratory (see paragraph 1.3 SUBMITTALS, subparagraph "Testing Laboratory"). Sampling and testing shall be performed as specified herein. The Contractor shall also be responsible for all sampling and testing specified in this Section.

#### 3.7.1 Testing Procedures

Specimens for acceptance tests shall be molded and cured in accordance with the referenced ASTM test procedure, where no standardized test procedure exist, the manufacturer's recommended procedure shall be followed. The specimens shall be cured and maintained in a condition representative of the in place coating.

#### 3.7.2 Material Testing

##### 3.7.2.1 Initial Material Testing

Each batch of coating Component A, coating (components A and B mixed per manufacturer's recommendations), and epoxy filler shall be tested prior to use in the work. A batch is a quantity of either Component A or Component B that is processed as a lot at the factory. Two randomly selected one-quart samples of each batch shall be collected at the job site, and labeled with the Project Contract number, manufacturer, type, batch number, batch quantity, tank that the material is to be used in and the intended use. Samples shall be collected in the presence of the CO. The Contractor shall submit one sample of each batch to the CO and one sample of each batch to the independent testing laboratory, where compliance with the specified material requirements (see PART 2 PRODUCTS) shall be verified by testing. If a sample does not meet the specified requirements, the Contractor shall dispose of the entire batch represented by that sample. The mixing of Components A and B at the independent testing laboratory shall conform to the manufacturer's recommendations and the requirements of Paragraph MIXING OF EPOXY COATING MATERIAL.

### 3.7.2.2 Material Testing During Application

Samples of epoxy materials (for each component) shall be collected for each day of material application. Samples shall be identified as in paragraph "Initial Material Testing." The samples shall be of sufficient size to allow an adequate quantity of material for each test to be performed. The samples shall be catalogued and retained by the Contractor until final acceptance of the work. Daily test samples shall be tested to verify compliance with specified requirements only if during the course of the work problems arise which question the quality of the material. Daily epoxy primer and coating material samples shall be taken from the sprayer hose or at the sprayer pump inlet, all samples of freshly mixed materials shall be taken at the sprayer discharge nozzle at the location of coating application.

#### a. Coating Material Proportioning Tests

The proportions shall be tested by collecting fresh samples from the supply line immediately before the resin enters the mixer element. The separate components of the coating shall be collected in graduated bottles. The samples shall be timed and volumetrically measured to verify that the material proportions being delivered to the mixer element correspond to the manufacturer's recommended proportions. The coating component proportioning controls shall be adjusted as required and new samples taken until the proper proportions are achieved. Proportioning of coating shall be tested at the beginning of each application shift, once for ever 4 hours of application and whenever application equipment changes are made.

#### b. Coating Material Viscosity Tests

Immediately after verification of the coating material proportioning the viscosity of the final mixture shall be tested using a Brookfield Viscometer or an appropriate size Zahn cup. Viscosity testing shall be in accordance with the manufacturer's recommendations, and shall be subject to approval. The coating material viscosity shall conform to the manufacturer's recommended proportioning. The viscosity shall be re-tested every 2 hours during the application process. The viscosity during each test shall be compared to the initial viscosity. If the viscosity changes the Contractor shall immediately stop application and rerun the Proportioning Test making the required adjustments and retesting the viscosity prior to resuming application.

### 3.8 APPLICATION OF COATING

Coating shall be applied within the manufacturer's recommended potlife for the material based on the highest temperature condition within the tank. Only materials that have met the requirements of paragraph SAMPLING AND TESTING / subparagraph "Initial Material Testing" shall be used. The qualities of the coating shall be continually monitored in accordance with paragraph SAMPLING AND TESTING. Coating shall be applied by spraying unless otherwise indicated and the coating application method shall provide for a 50 percent overlap of

each successive pass of the sprayer unless recommended otherwise by the manufacturer of the coating and as approved by the CO. The spraying method shall ensure that the coating material is applied to the surface at an angle directly perpendicular to the surface being coated to the maximum extent possible. Coating shall be applied when the temperature of the air within the tank is between 10 degrees C (50 degrees F) and 32 degrees C (90 degrees F); and the surface temperature of the steel is between 10 degrees C (50 degrees F) and 32 degrees C (90 degrees F), and at least 3 degrees C (5 degrees F) above the dew point temperature of the air within the tank and the air temperature in the tank is either constant or decreasing. If the coating manufacturer recommends more restrictive temperature requirements for application, these more restrictive requirements shall be adhered to. The final total dry film thickness shall be in accordance with the manufacturer's or formulator's recommendations, but shall be not less than the thickness specified herein. The coating shall be cured in accordance with the manufacturer's instructions. The epoxy coating system shall be protected and maintained in accordance with the manufacturer's recommendations. Clean canvas shoe covers shall be used when walking on surfaces that have been cleaned or coated.

NOTES:

1. The application of each coat shall be continuous over the entire surface, free of cold joints in the coating; except, subject to approval, a cold joint may be permitted on the walls and columns to allow separation between coating application of the horizontal and vertical surfaces. The cold joint shall be constructed as recommended by the manufacturer of the epoxy coating and as approved by the CO.

2. At areas where wicking of the coating may occur such as where roof beams meet the roof plate additional coating material shall be applied to assure that the minimum coating thickness is provided.

3. The coating for floors may be applied in a single coat application if recommended by the coating manufacturer and as compatible with the manufacturer's recommendations concerning cold joints (see NOTE 1 above) and subject to approval of the CO. The single coat application shall be applied to the full coating mil thickness as specified herein for multiple coat applications.

The coating shall be formulated to provide a different color for each coat of the coating system. The coating colors shall be the manufacturer's standard colors or shall be colors specifically formulated for this project, and the colors shall be subject to approval. The first coat shall contrast with the surface being coated and the finish coat shall have the lightest color available (preferably white). The completed coating application shall provide a coating system with a minimum dry film thickness in accordance with the following:

a. Floor of Tank. Two coats are to be applied.

(1) First coat 0.38 mm (0.015 inches) thick.

(2) Second coat 0.38 mm (0.015 inches) thick.

TOTAL DRY FILM THICKNESS - At least 0.030 inches thick.

b. Walls of tank. Three coats are to be applied.

(1) First coat 0.25 mm (0.010 inches) thick.

(2) Second coat 0.254 mm (0.010 inches) thick.

(3) Third coat 0.254 mm (0.010 inches) thick.

TOTAL DRY FILM THICKNESS - At least 0.762 mm (0.030 inches) thick.

c. Roof, and Steel Columns. Two coats are to be applied.

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(1) First coat 0.254 mm (0.010 inches) thick.

(2) Second coat 0.254 mm (0.010 inches) thick.

TOTAL DRY FILM THICKNESS - At least 0.51 mm (0.020 inches) thick.

Wet film thickness measurements of the coating shall be taken in at least 4 locations for every 5.6 square meters (60 sq. ft.) of applied coating. Following completion of the application of the coating system the dry film thickness of the entire coating shall be verified by direct measurements as specified in paragraph FINAL INSPECTION.

The time between subsequent application of coatings shall begin not sooner than 8 hours or later than 16 hours after completing the previous coating, except where the manufacturer's recommendations advise otherwise, and as approved by the CO.

### 3.9 FINAL INSPECTION

#### 3.9.1 General

Seven days after all other work specified in this Section has been completed, a final inspection shall be made to verify that all surfaces are free of imperfections such as pinholes and blisters, to verify coating adhesion to the coated surfaces, and that the applied dry film thickness of the total coating system is equal to or greater than the minimum specified herein. Imperfections found during the inspections shall be repaired as recommended by the manufacturer and as approved by the CO.

#### 3.9.2 Coating Dry Film Thickness

The applied dry film thickness shall be measured in accordance with SSPC PA 2 except that tests will be performed at two 3 meter by 3 meter areas (one on the floor and one on the wall of the tank) as designated by the Contracting Officer. If the applied dry film thickness is not in compliance with these specifications additional readings shall be made to determine the extent of the deficiency. Locations and number of additional readings shall be as determined by the CO. Surface preparation prior to application of additional finish coating shall be as recommended by the MTR and as approved by the CO. Application of additional coating shall be as specified herein for application of the coating system.

#### 3.9.3 Pinhole Free Coating Testing

Use High Voltage Spark testing at a minimum of 100 volts/mil of applied coating to verify a pinhole free coating exists. The voltage setting shall be determined after the average reading from the dry film testing per SSPC PA 2 has been established. Testing shall be in accordance with NACE RP0188.

#### 3.9.4 Adhesion Tests

A minimum of ten test shall be performed in each tank. Locations for the tests shall be as directed by the CO. The test shall be performed in accordance with ASTM D 4541. The minimum acceptable value shall be 8.3 Mpa (1200 p.s.i.). If the test fails in the coating or at the bond surface, the coating shall be considered defective, the extent of the defective coating area shall be determined by additional adhesion (pull) tests radiating out from the failed specimen and in additional test areas as determined by the CO. The defective coating shall be removed by methods recommended by the coating manufacturer and approved by the CO. Damage to the coating as a result of the tests shall be repaired as recommended by the MTR and approved by the CO.

### 3.10 RECOVERY

Following completion of the tank coating application and all testing required to verify compliance with the specified requirements, the Contractor shall:

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Remove all debris from work in the tank including masking materials and temporary pipe plugs. Prior to closing the tank the floor shall be vacuumed to remove any remaining dust, abrasive or moisture.

END OF SECTION

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## SECTION 09900

## PAINTING, GENERAL

## 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 CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-02 (1991) 1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3273 (1986; R 1991) Resistance to Growth of Mold on the Surface of Interior Coating in an Environmental Chamber

ASTM D 3274 (1982; R 1988) Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation

ASTM D 4214 (1989) Evaluating the Degree of Chalking of Exterior Paint Films

## FEDERAL SPECIFICATIONS (FS)

FS TT-E-489 (Rev H) Enamel, Alkyd, Gloss, Low VOC Content

FS TT-E-505 (Rev B) Enamel (Odorless, Alkyd, Interior, High Gloss)

FS TT-E-506 (Rev K; Am 1) Enamel, Alkyd, Gloss, Tints and White (for Interior Use)

FS TT-E-508 Rev C; Am 1) Enamel, Interior Semigloss, Tints and White

FS TT-E-509 (Rev C) Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints

FS TT-E-545 (Rev C) Primer (Enamel-Undercoat, Alkyd, Odorless, Interior, Flat, Tints and White)

FS TT-P-30 (Rev E; Am 1) Paint, Alkyd, Odorless, Interior, Flat, White and Tints

FS TT-P-31	(Rev D) Paint, Oil: Iron-Oxide, Ready-Mixed, Red and Brown
FS TT-P-37	(Rev D; Am 4 Reinstatement Notice) Paint, Alkyd Resin: Exterior Trim, Deep Colors
FS TT-P-38	(Rev E) Paint, Aluminum (Ready-Mixed)
FS TT-P-102	(Rev F) Paint, Oil, (Alkyd Modified, Exterior, Low VOC)
FS TT-P-645	(Rev B) Primer, Paint, Zinc-Molybdate, Alkyd Type
FS TT-P-650	(Rev D) Primer Coating, Latex Base, Interior, White (for Gypsum Wallboard, or Plaster)
FEDERAL STANDARDS (FED-STD)	
FED-STD 313	(Rev C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD 595	(Rev B) Colors Used in Government Procurement
MILITARY SPECIFICATIONS (MS)	
MS MIL-P-26915	(Rev C) Primer Coating, Zinc Dust Pigmented, for Steel Surfaces
MS MIL-P-28577	(Rev B) Primer, Water Reducible, Corrosion Resistant, for Metal Surfaces
MS MIL-P-28578	(Rev B) Paint, Water Reducible, Semi-Gloss Exterior and Interior
MS MIL-P-28582	(Basic; Notice 1) Primer Coating, Exterior, Lead Pigment-Free (Undercoat for Wood, Ready-Mixed, White and Tints)
STEEL STRUCTURES PAINTING COUNCIL (SSPC)	
SSPC Paint 5	(1991) Zinc Dust, Zinc Oxide and Phenolic Varnish Paint
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)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1989) Hand Tool Cleaning

SSPC SP 3 (1989) Power Tool Cleaning  
SSPC SP 7 (1991) Brush-Off Blast Cleaning

## 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 SUBMITTALS:

### Data

Paint; FIO.

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials when the required quantity of a particular batch is 50 gallons or less.

### Instructions

Mixing and Thinning; FIO. Application; FIO.

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. MSDS submittals shall meet the requirements of FED-STD 313. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats for epoxy, moisture-curing polyurethane, and liquid glaze coatings. Detailed application instructions for textured coatings shall be provided.

### Certificates

Lead; FIO. Mildewcide and Insecticide; FIO.  
Volatile Organic Compound (VOC) Content; FIO.

Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use contain not more than 0.06 percent lead. Certificate stating that paints proposed for use meet the VOC regulations of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

## 1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

## 1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports furnished with them. If materials are approved based on test reports

furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

#### 1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned, epoxy, and moisture-curing polyurethane coatings. Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F.

#### 1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

##### 1.6.1 Worker Exposures

Exposure of workers to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation.

##### 1.6.2 Toxic Compounds

Toxic compounds having ineffective physiological properties, such as odor or irritation levels, shall not be used unless approved by the Contracting Officer.

##### 1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MSDS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

##### 1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

## PART 2 PRODUCTS

### 2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the respective specifications listed for use in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary

paint material with similar intended usage and color to that specified may be used. Additional requirements are as follows:

#### 2.1.1 Colors and Tints

Colors shall be as selected from FED-STD 595. Tinting of epoxy, and urethane, paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

#### 2.1.2 Mildewcide and Insecticide

Paint specified for all coats applied to fabrics and vapor barrier jackets shall contain a mildewcide that will not adversely affect the color, texture, or durability of the coating. The mildewcide shall be incorporated into the paint by the manufacturer and shall attain a surface disfigurement rating of 8 or greater when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Mercurial mildewcide shall not be used in interior paint. Insecticides shall not be used in paint.

#### 2.1.3 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

#### 2.1.4 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

#### 2.1.5 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

### PART 3 EXECUTION

#### 3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

#### 3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. Cleaning solvents shall be of low toxicity with a flashpoint in excess of 100 degrees F. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer

capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

### 3.2.1 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

### 3.2.2 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces shall be solvent-cleaned in accordance with SSPC SP 1.

### 3.2.3 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a cloth, or vacuum-cleaning prior to application of the first-coat material. A damp cloth or sponge may be used if paint will be water-based.

### 3.2.4 Previously Painted Surfaces

Previously painted surfaces damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas. Edges of chipped paint shall be feather edged and sanded smooth. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8. New, proposed coatings shall be compatible with existing coatings. If existing surfaces are glossy, the gloss shall be reduced.

## 3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed local limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

## 3.4 APPLICATION

Painting practices shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be

of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

#### 3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

#### 3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

#### 3.4.3 First Coat

The first coat on gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall be wiped off after each application. The first coat on both faces of wood doors shall be applied at essentially the same time. Glazed doors and sashes shall be given the specified coating system within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 70 mils all around. Each varnish coat shall be sanded lightly prior to application of subsequent coats.

#### 3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

#### 3.4.5 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

### 3.5 PIPE IDENTIFICATION

Provide label indicating pipe contents and flow direction for all above ground fuel piping. Label shall be provided adjacent to all valves, at not more than 40 foot spacing on straight pipe runs, adjacent to change in direction, and on

both sides where pipes pass through walls or floors. The arrows shall be installed adjacent to each legend to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters and specify type of fuel. Letter sizes shall be as listed in TABLE I. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE 1. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	8 x 2-1/4	1-1/4
8 to 10	12 x 4-1/2	2-1/2
Over 10	12 x 4-1/2	3-1/2

### 3.6 MISCELLANEOUS PAINTING

#### 3.6.1 Lettering

Lettering required for pipe legend shall be block type, and shall be water-type decalcomania, finished with a protective coating of spar varnish. Samples shall be approved before application.

### 3.7 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

### 3.8 SURFACES NOT TO BE PAINTED

Surfaces in the following areas are not to be painted: Metal panels with factory color finish. In addition surfaces of hardware, fittings, and other factory finished items shall not be painted.

### 3.9 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

### 3.10 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by -----or----- between optional systems or coats.

## EXTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Ferrous metal unless otherwise specified	SSPC Paint 5	FS TT-P-38	FS TT-P-38
	SSPC Paint 25	SSPC Paint 21, Type 1	SSPC Paint 21 Type 1
		FS TT-P-102	FS TT-P-102
		FS TT-P-37	FS TT-P-37
		FS TT-P-31	FS TT-P-31
		MS MIL-P-28577	MS MIL-P-28577
Galvanized.	SSPC Paint 5 -----or----- MS MIL-P-26915, Type I, Class A	FS TT-P-102	FS TT-P-102

## INTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Gypsum board: latrine, unless otherwise specified.	FS TT-P-650	FS TT-E-505 ----- --or----- FS TT-E-506	None ----- ----- None
Metal in latrine other than equipment, machinery	Ferrous metal: SSPC Paint 5 ----- FS TT-P-645	FS TT-E-545	FS TT-E-505 -----or----- FS TT-E-506
Ferrous metal unless otherwise specified, including underside of zinc- coated and steel roof decking where exposed in areas having painted walls	SSPC Paint 5 ----- SSPC Paint 25 ----- FS TT-P-645	FS TT-P-30 ----- FS TT-E-545 ----- FS TT-P-102 ----- FS TT-P-38 -----	FS TT-E-508 -----or----- FS TT-E-509 ----- FS TT-E-505 -----or----- FS TT-E-506 ----- FS TT-P-102 ----- FS TT-P-38 -----
Ferrous metal factory-primed mechanical and electrical equipment.	FS TT-E-489, -----or----- SSPC Paint 21, Type I	FS TT-E-489, ----- SSPC Paint 21, Type I	None ----- None
Galvanized: unless otherwise specified.	SSPC Paint 5	Two coats of paint to match adjacent areas	

## INTERIOR PAINTING SCHEDULE (Con.)

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>	<u>Third Coat</u>
Wood: unless otherwise specified	FS TT-E-545	FS TT-P-30	
		None	
		FS TT-E-508	None
		-----or----- FS TT-E-509	None
Metal: Convector enclosures, electrical conduit runs, metallic tubing, uninsulated ducts and pipes, pipe hangers, louvers, grilles, and air outlets in areas having painted adjacent surfaces.	Ferrous metal: SSPC Paint 5  SSPC Paint 25  FS TT-P-645  Galvanized surface: SSPC Paint 5	FS TT-E-545	FS TT-E-506 -----or-----
			FS TT-E-508 -----or-----
			FS TT-E-509
		FS TT-P-30	FS TT-P-30
		FS TT-E-489	FS TT-E-489

END OF SECTION

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## SECTION 09925

EXTERIOR COATING SYSTEM FOR WELDED  
STEEL PETROLEUM STORAGE TANKS

## 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.

## CODE OF FEDERAL REGULATIONS

29 CFR 1910.134 Respiratory Protection

29 CFR 1910.1000 Air Contaminants

29 CFR 1910.1200 Hazard Contaminants

## FEDERAL STANDARDS (FED-STD)

FED-STD-595 (Rev B) Color Used in Government Procurement

## MILITARY SPECIFICATIONS (MS)

MS MIL-B-131 (Rev H; Int Am 1) Barrier Materials,  
Waterproof, Greaseproof, Flexible, Heat  
Sealable

MS MIL-C-81907 (Am 1) Coating System, Polyurethane,  
Aliphatic, Weather Resistant Process for  
Application of

MS MIL-C-85285B (Rev B; Am 2) Coatings: Polyurethane, High-  
Solids

MS MIL-P-3420F (Ref F) Packaging Materials, Volatile  
Corrosion Inhibitor, Treated, Opaque

MS MIL-P-24441/19A Paint, Epoxy-Polyamide, Zinc Primer, Formula  
159, Type II

MS MIL-P-24441/27 Paint, Epoxy-Polyamide, No 50 Gray, Formula  
157, Type III

## MILITARY STANDARDS (MIL-STD)

MIL-STD 161 (Rev. F; Notice 1 & 2) Identification Methods  
for Bulk Petroleum Products Systems Including  
Hydrocarbon Missile Fuels

## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC PA 2	(1991) Measurement of Dry Paint Thickness with Magnetic Gages
SSPC SP 10	(1991) Near-White Blast Cleaning
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)

## 1.2 SYSTEM DESCRIPTION

This specification covers the requirements for epoxy/polyurethane coating systems for exteriors of newly constructed steel tanks for storage of petroleum products.

## 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 SUBMITTALS:

### Instructions

Coating System; GA.

Three copies, before application, of the supplier's (formulator's) printed instructions which include brand names, catalog numbers, and names of manufacturers. Instructions shall include detailed mixing and application procedures except as modified herein, number and types of coats required, minimum and maximum application temperatures, curing procedures, pot life, and shelf life.

### Statements

Safety; GA.

Six copies of material safety data sheets (MSDS) for materials to be used at the job site in accordance with 29 CFR 1910.1200.

### Certificates

Coating System; FIO.

Four certificates of compliance attesting that the materials proposed for use meet the requirements specified.

## 1.4 DELIVERY AND STORAGE

Epoxy and polyurethane materials shall be shipped and stored out of the sun and weather, preferably in air conditioned spaces.

## 1.5 SAFETY

The Contractor shall ensure that employees are trained in the requirements of CFR 29 CFR 1910.1200 and understand the information contained in the material

safety data sheets for their protection against toxic and hazardous chemical effects.

## 1.6 JOB SITE REFERENCES

The Contractor shall have at least one copy of each of SSPC SP 10, SSPC PA 2, and SSPC VIS 1 at the job site and which are readily available to the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 COATING SYSTEM

The coating system shall conform to the respective specifications and to the requirements specified herein.

#### 2.1.1 Primer

Epoxy polyamide, zinc rich primer, formula 159 of MS MIL-P-24441/19A.

#### 2.1.2 Intermediate Coat

Epoxy polyamide, No. 50 gray intermediate coat, formula 157 of MS MIL-P-24441/27.

#### 2.1.3 Topcoat

Polyurethane coating topcoat of MS MIL-C-85285B, Type II (white FED-STD-595, color number 17925).

#### 2.1.4 Vapor-Tight Material

MS MIL-B-131 or MS MIL-P-3420F.

### 2.2 COLOR

Piping, conduit, and tank identification shall be in accordance with MIL-STD 161. Mark direction of fluids in accordance with MIL-STD 161.

## PART 3 EXECUTION

### 3.1 SAFETY

Coatings specified may have potential health hazards if ingested or improperly handled. Follow manufacturer's written safety precautions throughout the mixing, application, and cure of the coatings.

### 3.2 PROTECTION FROM TOXIC AND HAZARDOUS CHEMICAL AGENTS

During tank cleaning, cleanup, surface preparation, and paint application phases, ensure employees are adequately protected from toxic and hazardous chemical agents which exceed the concentrations in 29 CFR 1910.1000. Comply with respiratory protection requirements in 29 CFR 10910.134.

#### 3.2.1 Epoxy-Polyamide Coating Hazards

MS MIL-P-24441 formulations have a minimum flash point of 35 degrees C (95 Degrees F). Solvent fumes from epoxy paint systems are combustible and toxic. Take suitable precautions to prevent their accumulations. In addition to

fire and toxic hazard, epoxy coatings can cause allergic reactions when allowed to come in contact with the skin. Prompt skin cleanup after contact using soap and water, not solvents, is recommended. Solvents will thin and spread paint over the skin, permitting deeper penetration and increasing the hazard of a delayed allergic reaction.

### 3.2.2 Health

Operations shall be reviewed and approved by an industrial hygienist as to correctness of work procedures and personal protective equipment. Services of the industrial hygienist shall be obtained by the Contractor.

### 3.3 WEATHER CONDITIONS

Accomplish abrasive blasting and coating operations when the ambient air temperature is above 4.44 degrees C (40 Degrees F), below 35 degrees C (95 Degrees F), and the steel surface temperature is more than 3 degrees C (5 Degrees F) above the dew-point of the ambient air. Coatings shall not be applied to damp or wet surfaces.

### 3.4 SURFACE PREPARATION

Grind rough surfaces smooth on weld seams, sharp edges and corners to a minimum of a 3 mm radius. Abrasive -blast surfaces to near-white metal in accordance with SSPC SP 10. Prior to commencing blasting, prepare a 305 mm square steel test-plate for the appearance shown in SSPC VIS 1. Submit the sample to the Contracting Officer. Use the approved sample test-plate as a standard of comparison for the tank surfaces throughout the course of work. Keep test plate wrapped and sealed using material specified in the paragraph entitled "Vapor-Tight Material" in order to retain the appearance. Blasting equipment shall be conventional air, force-feed, or pressure type. No type of water or vapor blast will be permitted. Provide nozzle of such size that a pressure of 44 Kpa plus or minus 6.9 Kpa (90 plus or minus 10 psig) is maintained at the blast generator. Filter and separate oil and moisture from the air supply, and determine quality of air by blowing through a clean cloth. Blast in sections or blocks small enough to permit application of the zinc-rich epoxy coating during the same working shift. Time interval between blasting and application of the zinc-rich epoxy coating shall not exceed 8 hours. Abrasive-blast surfaces shall match the prepared test-plate. After abrasive-blasting, clean surfaces by brushing, blowing with oil-free and moisture-free compressed air, or vacuuming. Free surfaces of dust and debris. Weld sharp depressions or deep pits and grind-off smooth.

### 3.5 APPLICATION OF COATING SYSTEM

#### 3.5.1 General

Dry film thickness (DFT) coating system shall be as specified below. Complete coating system shall be:

- a. 1st Coat: formula 159 epoxy-polyamide zinc rich primer, MS MIL-P-24441/19A, 0.051 mm to 0.102 mm (2-4 mils)DFT.

b. 2nd Coat: Formula 157 epoxy-polyamide No. 50 gray intermediate coat, MS MIL-P-24441/27; 0.051 mm to 0,102 mm (2 to 4 mils) DFT.

c. 3rd and 4th Coat: Polyurethane white topcoat, MS MIL-C-85285B, Type II, 0.038 mm to 0.051 mm (1-1/2 to 2 mils) DFT each coat.

### 3.5.2 General Procedure

Apply primer coat as soon as practical after abrasive blast cleaning. In no case shall the time interval exceed 8 hours. If visible rusting occurs; regardless of the time period, reblast the surface prior to applying primer coat. Coat exterior surfaces of the tank including steel roof, shell, stair, railing, and other exterior appurtenances. Coating system shall be applied by experienced applicators. Apply two coats of primer over corners, crevices, and welds. Apply the additional coat of primer by brush, working the material into corners, crevices, and welds, and outside corners and angles after the general application of the primer coat. Two coats of epoxy (Formula 159 and Formula 157) shall be applied successively allowing a drying time of not less than 16 hours nor more than 48 hours between coats for the epoxy coatings and no more than 16 hours for the MS MIL-C-85285 polyurethane. Each of the epoxy coats shall have a dry film thickness (DFT) from 0.051 mm to 0.102 mm (2 to 4 mils) and each of the polyurethane coats, 0.038 mm to 0.051 mm (1-1/2 to 2 mils). The total dry film thickness (DFT) of the coating system shall be not less than 7 mils. If necessary to obtain the required minimum thickness of 0.18 mm (7 mils) an additional topcoat shall be applied within 16 hours.

### 3.5.3 Epoxy-Polyamide Coating Application

Epoxy-polyamide coatings, MS MIL-P-24441/19A or 27 may be applied by brushing, airless spraying, or dip application.

### 3.5.4 Tack Coat for Polyurethane Topcoat

Application of the polyurethane topcoat MS MIL-C-85285B shall be made after the second coat of the epoxy (Formula 157) has cured thoroughly (8 to 16 hours depending on the ambient temperature). If the epoxy coating cures for more than 16 hours, a tack or mist coat of 0.025 mm to 0.051 mm (1 to 2 mils) wet film thickness (WFT) shall be applied and dried 8 hours before applying the topcoat. Tack coat shall be the same material as the preceding coat of epoxy. If more than 7 days has elapsed since the last coat of epoxy, clean surfaces with water and detergent and rinsed clean with fresh water. If required, use solvents for grease and oil removal. Then apply a tack coat 0.025 mm to 0.051 mm (1 to 2 mils WFT) of Formula 157 to the cured coat and allowed to dry approximately 4 hours before application of the polyurethane topcoat.

### 3.5.5 Application of Polyurethane Coating

Apply in accordance with MS MIL-C-81907.

## 3.6 FINAL INSPECTION

Following completion and curing of the coating system, inspect coated surfaces for pinhole, blisters, inadequate coating thickness, and other defects. Measure the dry film thickness in accordance with SSPC PA 2 at several random points throughout the tank as designated by the Contracting Officer. Repair imperfections found or so designated by the Contracting Officer. If the average measurements are less than the specified minimum dry film thickness, take additional readings in adjacent areas to define the extent of the thin

area. Coat such areas with white polyurethane topcoat as necessary to achieve specified thickness. Apply coating within the conditions specified in paragraph entitled "Application of Coating System." Lightly brush blast or hand sand thin areas found to remove the glossy surface of the topcoat before applying additional topcoat if the topcoat was applied more than 48 hours in advance.

### 3.7 FINAL CLEANUP

Following completion of the work, remove debris, equipment, and materials from the site. Remove temporary connections to Government or Contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

### 3.8 CARE OF COATING

Coating shall be intact at completion of contract. Any damage to coating due to welding, chipping or other causes shall be repaired as stipulated in the paragraph: FINAL INSPECTION

END OF SECTION

SECTION 10430  
EXTERIOR SIGNAGE

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 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	(1990) Structural Steel
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 525	(1990) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM B 26	(1991) Aluminum-Alloy Sand Castings
ASTM B 108	(1991) Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(1990) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1991) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1990) Structural Welding Code - Steel
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 505	(1988) Metal Finishes Manual for Architectural and Metal Products; Section: Applied Coatings
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1.3 GENERAL

Exterior signage shall be of the size and type 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. Materials and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

#### 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 SUBMITTALS:

##### Drawings

Exterior signs; FIO.

Drawings including 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.

##### Instructions

Exterior Signs; FIO.

Manufacturer's descriptive data, catalog cuts, and installation instructions.

##### Samples

Exterior Signs; FIO.

One sample of each type of sign GA. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Two samples of manufacturer's standard color chips for each material requiring color selection.

#### 1.5 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area.

### PART 2 PRODUCTS

#### 2.1 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209 for sheet or plate, ASTM B 221 for extrusions and ASTM B 26 or ASTM B 108 for castings, as applicable. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge, 0.0508 inch thick.

#### 2.2 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a semi-gloss baked enamel or two-component acrylic polyurethane finish in accordance with NAAMM AMP 505 with total dry film thickness not less than 1.2 mils.

#### 2.3 STEEL PRODUCTS

ASTM A 36 for structural steel, ASTM A 570 for sheet and strip.

#### 2.4 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish.

## 2.5 SHOP FABRICATION AND MANUFACTURE

### 2.5.1 Workmanship

Work shall be assembled in the shop, insofar as practicable, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Weld to or on structural steel in accordance with AWS D1.1. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable. Items specified to be galvanized shall be by hot-dip process after fabrication if practicable. Galvanization shall be in accordance with ASTM A 123 and ASTM A 525, as applicable. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

### 2.5.2 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 asphalt varnish or a coat of zinc-chromate primer to prevent galvanic or corrosive action.

### 2.5.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-chromate primer, or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Do not paint surfaces of items to be embedded in concrete. Upon completion of work, thoroughly recoat all damaged surfaces.

## 2.6 CAST PLAQUES

### 2.6.1 Plaques

Metal plaques shall be 22 gauge steel plate per drawings.

Letter styles and sizes shall be as shown on the drawings. Letters shall be sharp and hand tooled. Faces of letters are to be polished satin finish.

Border style shall be standard design as shown on the drawings. Borders and faces shall have sharp hand tooled edges.

### 2.6.2 Mounting Method

Plaque mounting method shall be concealed fastening or rosette fastening.

## 2.7 PANEL AND POST/PANEL TYPE SIGNS

### 2.7.1 Posts

One-piece aluminum posts shall be provided with minimum 0.125 inch wall thickness. Posts shall be designed to accept panel framing system described herein. Caps shall be provided for each post. Finish for posts shall be semigloss baked enamel.

### 2.7.2 Panel Framing System

Panel framing angels to be aluminum.

### 2.7.3 Panels

Panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.090-inch aluminum. Finish for metal panels shall be semi-gloss baked enamel.

### 2.7.4 Mounting

Permanent mounting shall be provided by embedding posts in concrete foundation as shown.

## 2.8 GRAPHICS FOR PYLON/MONOLITH AND POST/PANEL TYPE SIGNS

### 2.8.1 Graphics

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 stencil of the original specified art. Edges and corners shall be clean. Rounded corners, cut or ragged edges, edge buildup, bleeding or surfaces pinholes will not be accepted.

### 2.8.2 Messages

See drawings for message content. Typeface: Helvetica medium. Type size as indicated. Color as indicated.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs shall be installed at locations shown on the drawings. All signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

#### 3.1.1 Anchorage

Anchorage not otherwise specified or indicated shall be machine carriage bolts for steel.

#### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Sign surfaces shall be cleaned.

END OF SECTION

SECTION 10800  
TOILET ACCESSORIES

## 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.

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2380	(Basic) Dispenser, Paper Towel
CID A-A-2524	(Basic) Holder, Toilet Paper (Single Roll)
CID A-A-2668	(Basic) Dispenser, Toilet Paper, Cabinet

## FEDERAL SPECIFICATIONS (FS)

FS DD-M-411	(Rev C) Mirrors, Glass
FS WW-P-541/GEN	(Rev E; Am 1) Plumbing Fixtures
FS WW-P-541/8	(Rev B; Am 1) Plumbing Fixtures (Accessories, Land Use)

## 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 SUBMITTALS:

## Data

Finishes; FIO. Accessory Items; FIO.

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, and operation instructions.

## Samples

Finishes; FIO. Accessory Items; FIO.

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

## 1.3 GENERAL REQUIREMENTS

Toilet accessories as specified herein shall be provided where indicated in accordance with paragraph SCHEDULE. Each accessory item shall be complete with the necessary mounting plates, anchors, and fasteners. Concealed

mounting plates shall be of sturdy construction with corrosion resistant surface.

### 1.3.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be well suited for use with the supporting construction. Where exposed fasteners are permitted, they shall have oval heads and finish to match the accessory.

## PART 2 PRODUCTS

### 2.1 FINISHES

Finishes on metal shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Stainless steel	Chromium plated, bright

### 2.2 ACCESSORY ITEMS

Accessory items shall conform to the respective specifications and other requirements specified below. All accessory items shall have a smooth finish.

#### 2.2.1 Facial Tissue Dispenser (FTD)

Facial Tissue Dispenser shall conform to FS WW-P-541/GEN and FS WW-P-541/8, Type I, Class 4, surface mounting, Type 304 stainless steel face. Dispenser shall have a capacity of 300 tissues.

#### 2.2.2 Grab Bar (GB)

Grab bar shall conform to FS WW-P-541/GEN and FS WW-P-541/8, Type IV, Class 2, 1-1/4 inches OD stainless steel. Grab bar shall be form and length as indicated. Exposed mounting flange shall have set screw mounting holes concealed on the lip of the flange. Grab bar shall have peened non-slip surface. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation.

#### 2.2.3 Mirror, Glass (MG)

Glass mirror shall conform to FS DD-M-411, Class 2, Style E.

#### 2.2.4 Paper Towel Dispenser (PTD)

Paper towel dispenser, conforming to CID A-A-2380, shall be constructed of not less than 0.0269 inch Type 304 stainless steel, shall be surface mounted, and shall dispense C-fold, single-fold, or quarter-fold towels. Capacity of dispenser shall be at least 400 C-fold or 525 multifold towels. Surface mounted dispenser shall have a towel compartment and a liquid soap dispenser. Locking mechanism shall be tumbler key lock.

#### 2.2.5 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall conform to CID A-A-2524, Type I, roller mounted on two support brackets with heavy-duty vandal resistant spindles. Bracket(s) shall be stainless steel. Toilet tissue cabinet shall conform to CID A-A-2668, stainless steel containing 2 rolls of tissue.

#### 2.2.6 Shelf, Metal, Light Duty (SMLD)

Light duty metal shelf shall conform to FS WW-P-541/GEN and FS WW-P-541/8, Type V. Shelf shall be supported between brackets or on brackets. Shelf and separate supports shall be stainless steel.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Toilet accessories shall be securely fastened to the supporting construction in accordance with the approved submittals. Accessories shall be protected from damage from the time of installation until acceptance.

#### 3.2 SCHEDULE

##### Accessories Required

Room or <u>Space</u>	<u>MG</u>	<u>PTD</u>	<u>SMLD</u>	<u>SD</u>	<u>SH</u>	<u>TTD</u>	<u>FTD</u>
Toilet Room	1	1	1	-	-	1	1

END OF SECTION



## SECTION 11303

WASTE FILTRATION SYSTEM  
(OIL-WATER SEPARATOR)

## PART 1 GENERAL

## 1.1 SUMMARY (Not Applicable)

## 1.2 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.

## FEDERAL SPECIFICATIONS (FS)

WW-U-531 (Rev F) Unions, Pipe, Steel or Malleable Iron;  
Threaded Connection, 667 Newton Tons, 1,112 Newton  
Tons and 1,335 Newton Tons

## MILITARY SPECIFICATIONS (MS)

MIL-Y-1140 (Rev H, Am 1) Yarn, Cord, Sleeving, Cloth, and  
Tape-Glass

MIL-R-7575 (Rev C, Am 2) Resin, Polyester, Low Pressure  
Laminating

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.3 (1985) Malleable Iron Threaded Fittings

ANSI B16.5 (1988) Pipe Flanges and Flanged Fittings

## AMERICAN PETROLEUM INSTITUTE (API)

SPEC 5L (1988) Line Pipe

## AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)

Standard Methods for the Examination of Water and Wastewater

## U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Methods for Chemical Analysis of Water and Wastes

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1988, Rev A) Pipe, Steel, Black and Hot-Dipped,  
Zinc-Coated Welded and Seamless

ASTM A 105/A105M	(1987, Rev A) Forgings, Carbon Steel, for Piping Components
ASTM A 181/A181M	(1987) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 234/A234M	(1988) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM D 2996	(1988) Filament-Wound 'Fiberglass' (Glass Fiber-Reinforced Thermosetting Resin) Pipe
ASTM D 2997	(1984) Centrifugally Cast Reinforced Thermosetting Resin Pipe
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA No. 30	(1987 Flammable and Combustible Liquids Code
STEEL STRUCTURES PAINTING COUNCIL (SSPC)	
SP 10	(1985) Near-White Blast Cleaning
UNDERWRITERS LABORATORIES INC. (UL)	
UL 58	(1986) Steel Underground Tanks For Flammable and Combustible Liquids
UL 1316	(1983) Glass-Fiber-Reinforced Plastic Underground Storage Tanks For Petroleum Products

### 1.3 GENERAL REQUIREMENTS

The plans indicate system location and associated piping. If any departures from the contract drawings or the provisions of this section of the specification are deemed necessary by the Contractor, details and reasons therefore shall be submitted prior to fabrication or installation of the affected item(s). No such departures shall be made without prior written approval of the Contracting Officer.

#### 1.3.1 Applications

The waste filtration system shall remove free oil and suspended solids from oil-in-water mixtures of freshwater originating from fuel spills. The influent oil-in-water mixture will flow by gravity to the system which will be located underground.

#### 1.3.2 Influent Characteristics

The capacity of the oil water separator shall be sized using the following conditions, to meet the effluent criteria of paragraph 1.3.3

Oil-Water Separator		
Flowrate, maximum	750	<del>1-ppm</del> <u>liters/min</u>

Oil density	0.83	gm/cc
Inlet oil concentration	100	ppm
Mean oil droplet size	120	micron

The waste filtration system shall be designed to operate from 0 to 100 percent of the maximum flow without adverse impact to the system or to the effluent stream; for influent flows with operating temperatures from 0 to 38 degrees C; and for ambient air temperatures from -20 to 40 degrees C.

### 1.3.3 Performance

Grease, oil, and Petroleum hydrocarbon concentration in the effluent from the waste filtration system shall not exceed the following:

Total grease and oil, daily maximum	20 mg/l
Petroleum hydrocarbon, daily maximum	20 mg/l
Suspended solids concentration	100 mg/l

The system shall be capable of removing all free oil droplets greater than 20 microns in size. The system shall also provide storage for a minimum of 1,500 liters of removed oil.

### 1.3.4 Configurations

Final dimensions and configuration of actual unit(s) and all components and parts relating thereto shall be the Contractor's responsibility.

1.3.4.1 The waste filtration system shall be designed to accomplish the following:

- a. Grit removal and storage
- b. Sludge removal and storage
- c. Oil removal and storage

1.3.4.2 In addition, the system shall have the following features:

- a. Secondary containment, sized to accommodate maximum total system capacity in liters
- b. Manway access to each compartment and chamber of the system
- c. Operation by gravity flow

### 1.3.5 Standard Products

Each integral unit of the waste filtration system shall be a standard product of a single manufacturer regularly engaged in the manufacture of said product. Piping and leak detection systems may be products of separate manufacturers.

#### 1.3.6 Nameplates

Manufacturer's name, address, type or style, model or serial number, and catalog number on a plate shall be secured to each major item of equipment.

#### 1.3.7 Related Work

Cast-in-place concrete is included in SECTION: CONCRETE FOR BUILDING CONSTRUCTION. Excavation is included in SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

### 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 01330: SUBMITTAL PROCEDURES.

#### Detail Drawings

Detail drawings shall show proposed layout of system, including schematics of all piping and wiring; proposed anchorages and foundations of all components, equipment, and appurtenances of system; and proposed dimensions, slopes, tolerances, etc. which describe the system as a whole and relate the system to existing site conditions. Detail drawings shall demonstrate that the system design has been coordinated and that the system will function as a whole.

#### Material and Equipment List

Complete list of equipment and materials; manufacturer's descriptive and technical literature, performance charts and curves, including pressure test acceptance criteria; catalog cuts; and handling and installation instructions.

#### Test Reports

Upon completion and testing of the installed system, reports shall be submitted in booklet form showing all field tests. Each report shall indicate points inspected or tests and adjustments made, and final position of controls and gauges and other indicators. Each report shall indicate results of tests, observations, related inspections, operations, or adjustments of the system or system components. Certification shall be obtained from the manufacturers which demonstrates compliance with the specified performance criteria in paragraphs "Applications," "Influent Characteristics," and "Performance" above. Certification shall be based on component tests conducted within the last 2 years. Certification shall be obtained from the manufacturers which states that the installed equipment is ready for permanent operation and that nothing in the installation or configuration of the equipment will render the manufacturers' warranties null and void.

#### Operation and Maintenance Manuals

O&M manuals shall be prepared and submitted in accordance with the SUPPLEMENTARY REQUIREMENTS. The O&M manuals shall contain:

Instructions outlining step-by-step procedures required for system start-up, operation, and shutdown. Instructions shall include manufacturers' names, model numbers, service manuals, parts list, and brief descriptions of all pieces of equipment and their basic operating features.

Maintenance instructions listing routine maintenance procedures, possible breakdowns, and repairs. Instructions shall include simplified wiring and control diagrams for the system as installed.

#### Spare Parts Data

After approval of detail drawings, and not later than 1 month prior to beneficial occupancy date, the Contractor shall furnish spare parts data for each different specified item of equipment. Data shall include a complete list of parts and supplies, with current unit prices and sources of supply and a recommended spare parts list for 1 year's operation.

#### 1.5 DELIVERY AND STORAGE

All equipment shall be handled minimally and shall be placed in storage such that protection from the weather, humidity, temperature variations, sunlight, dirt, dust, and other contaminants is provided.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

##### 2.1.1 Waste Filtration System, General

System shall be constructed of prefabricated unit(s) containing separately or integrally the functions set forth in paragraph 1.3.4.1 above. Unit(s) shall be either double-wall type constructed in mild steel or of glass fiber reinforced polyester resin (FRP), or shall be FRP contained in a concrete vault in accordance with paragraph 1.3.4.2 above.

##### 2.1.2 Waste Filtration System

Units shall be fabricated and tested in accordance with UL and NFPA standards. Unit(s) shall be UL listed and shall bear the UL label.

##### 2.1.3 Manways:

A manhole opening not less than 750 mm in diameter with matching watertight cover shall be provided for access to the grit collection/storage compartment or unit, to the sludge collection/storage compartment or unit, and to the oil coalescing compartment or unit. Oil coalescing compartment or unit manhole opening shall be large enough for removal and reinstallation of coalescing media. Access to interiors of compartment(s) and unit(s) shall be provided by extending the manhole opening as needed and covering the opening with a matching watertight cover. Manhole extension shall be of the same material as the unit and shall have the same or greater wall thickness as the unit. The manhole extension shall be enclosed in a concrete pipe of at least 1.5 times the diameter of the extension. The concrete pipe shall not rest on the unit or be supported by the unit or the extension. The concrete pipe shall extend to a concrete pad in which is set a heavy duty cast iron frame and cover. Pad and cover shall be set flush with finished grade in paved areas and 50 mm above finished grade in unpaved areas.

##### 2.1.4 Double-Wall Unit(s)

2.1.4.1 Steel unit(s) shall all be welded, and shall be fiberglass resin coated and cathodically protected in accordance with manufacturer's recommendations.

2.1.4.1.1 Steel unit(s) shall be suitable for underground installation and shall be constructed and labeled in accordance with NFPA No. 30. Each unit shall be secured to, but shall not be placed directly on, concrete pads sized and designed to prevent flotation of the empty unit when ground is saturated with water. Unit anchoring straps shall be electrically insulated from the unit.

2.1.4.1.2 Exterior coating of steel unit(s) shall be shop applied using glass fiber conforming to MS MIL-Y-1140 and corrosion resisting grade polyester resins meeting Grade B (superior) requirements of MS MIL-R-7575 for physical strength. The exterior of the steel unit(s) shall be prepared by removing all weld spatter and rough or sharp edges by chipping or grinding. Surfaces and joints shall be sandblasted to "near white metal" in accordance with SSPC SP 10 and cleaned of all dust by vacuuming or air brushing. After cleaning, surfaces shall be kept free of fingerprints and other contamination. Local surface cleaning may be accomplished using clean, lint free cloth and industry approved liquid detergent. Coating shall not be applied if either the steel or the ambient temperature is below 16 degrees C. Sprayed resin material shall be heated to 32 degrees C. prior to and during the spraying operation. Catalyst concentration shall be varied to compensate for variation in humidity and temperature. A thin coat of resin-catalyst mixture shall first be applied to the area being worked then followed by the full thickness of chopped glass fiber-resin catalyst. After application, the coating shall be rolled with special slotted rollers in full motion with overlapping passes along entire unit, to remove all air bubbles and pack all loose strand ends. A seal coat of resin-catalyst mixture, without chopped fiber, shall then be applied to entire unit surface. The final thickness shall be not less than 6 mm at any point.

2.1.4.1.3 Coating shall be examined for flaws; tested for holidays; and its thickness shall be measured as a Contractor Quality Control requirement. The Contractor shall provide the facilities, personnel, and equipment to test for holidays and coating thickness. Thickness of coating shall be measured by commercial film-thickness gage. Directly prior to placement, coating shall be tested with an electric flaw detector, equipped with a bell, buzzer, or other type of audible signal that operates when a holiday, pinhole, or other defect is detected. The holiday test shall be performed at dielectric resistance of 35,000 volts or that voltage which is specified (in writing) by the manufacturer. A Tinker and Razor model AP-W Holiday Detector or equivalent at 35,000 volts is acceptable. Check of the holiday detector potential may be made by the Contracting Officer at any time to determine suitability of the detector. Damaged areas, including areas damaged by thickness testing, shall be repaired with materials identical to those used originally and, after drying shall be retested electrically as previously specified. Record of test and test report shall be submitted together with the Construction Quality Control daily report.

2.1.4.2 FRP unit(s) shall be suitable for underground installation and shall conform to requirements of UL and NFPA standards and codes. Each unit shall be secured to, but shall not be placed directly on, concrete pads sized and designed to prevent flotation of the empty unit when ground is saturated with water. Hold-down straps shall be glass fiber reinforced plastic.

2.1.4.3 Leak Detection System:

Leak detection system shall indicate occurrence of a leak in any part of either shell of each unit, and shall be UL listed. All materials and

appurtenances as required by manufacturer's installation recommendations shall be provided. Leak detection system shall include an audible alarm and shutoff.

#### 2.1.5 FRP Unit(s) in Vault

Vault shall be of precast or cast-in-place concrete. At least one manway shall be provided: manway shall be not less than 750 mm in diameter. The vaulted area shall be sufficient in volume to enable visual inspection of the unit(s) on all sides including the bottom, and any piping and joint connections. The vault as a unit shall be capable of containing system influent without leakage. All openings through the vault shall be adequately sealed to prevent leakage.

#### 2.1.6 Pipe

##### 2.1.6.1 Steel Pipe

Pipe shall be black carbon steel, ASTM A 53, Type E or S, Grade A or B, Schedule 40.

##### 2.1.6.2 Plastic Pipe

Pipe shall conform to ASTM D 2996 or ASTM D 2997 or be products UL approved for the service intended. Use of plastic piping is limited to buried service only and at pressures not exceeding that marked on the pipe.

#### 2.1.7 Steel Pipe Fittings

Steel pipe fittings shall conform to the following:

##### 2.1.7.1 Welding Fittings

Carbon Steel, ASTM A 234, WPB.

##### 2.1.7.2 Threaded Fittings

Malleable iron, 0.67 Newton Tons, ANSI B16.3.

##### 2.1.7.3 Flanged Fittings

Carbon steel, ANSI B16.5, ASTM A 181, or A 105.

##### 2.1.7.4 Couplings

API 5L, seamless, extra heavy, wrought steel with recessed ends.

##### 2.1.7.5 Nipples

ASTM A 733 and of the same material as the pipe supplied.

##### 2.1.7.6 Unions

FS WW-U-531.

#### 2.1.8 Plastic Pipe Fittings

Fittings shall be of same material as pipe supplied and compatible with adhesives used for joining the pipe.

### 2.1.9 Joint Compound

All joint compounds for piping system shall be resistant to water and shall be suitable for use with fuel containing 40 percent aromatics.

### 2.1.10 Flange Gaskets

Gaskets shall be fabricated from a homogenous synthetic rubber base or resin base material suitable for the application. Gasket stock shall be approximately 2.5 mm thick in its free state and 3 mm thick after compression in a flanged joint.

### 2.1.11 Waste Oil Storage

Waste oil storage compartment/unit shall be fitted with a suction line; atmospheric vent; and remote reading oil level sensor with high and low level settings and high level audible alarm and shutoff. If storage of waste oil is not integral to waste filtration system, then oil shall be removed from the oil coalescing compartment/unit by appropriate skimmer(s) and gravity feed.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Installation of Waste Filtration System Unit(s)

Unit(s) shall be handled to prevent damage during transportation to the site and installation. A unit may be inspected at any time by the Contracting Officer prior to installation: any damaged unit shall be repaired under direct supervision of the unit manufacturer and shall be subjected to the manufacturer's air pressure test, as required in paragraph 3.2.1 below. Unit(s) shall be handled and installed in strict accordance with the manufacturer's written recommendations.

#### 3.1.2 Installation of Leak Detection System

Leak detection system shall be installed in strict accordance with manufacturer's written recommendations.

#### 3.1.3 Piping

Piping in the waste filtration system shall be steel or plastic. Plastic pipe only shall be used for buried lines. Piping connections to equipment shall be as indicated or as required by the equipment manufacturer. All unit connections shall be made with two elbow swing joints to allow for differential settlement. The interior of all piping shall be thoroughly cleaned of all foreign material before installation and shall be kept clean during installation. Piping shall not be placed in water or during conditions which are similarly unsuitable. When work is not in progress, open ends of pipe and fittings shall be securely closed to prevent entry of any foreign material. Any pipe, fittings, or appurtenances found defective after installation shall be replaced. Threaded joints shall be made with tapered threads and shall be made tight with joint compound applied to the male threads only.

##### 3.1.3.1 Cutting Pipe

Cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter.

Wheel cutters shall be used when practicable. Pipe shall be reamed to true internal diameter after cutting to remove burrs.

### 3.1.3.2 Installing Piping

Pipe and accessories shall be handled carefully to assure a sound, undamaged condition. Plastic pipe shall be installed in accordance with pipe manufacturer's instructions. Underground pipelines shall be laid with a minimum pitch of 8 mm per 300 mm or as shown on drawings. Valved drain connections shall be provided at low points, and valved vent connections shall be provided at high points. Piping passing through concrete or masonry construction shall be fitted with sleeves. Each sleeve shall extend through the associated structural member and shall be cut flush with each surface, and the sleeve shall be large enough to provide a minimum clear distance of 15 mm between the pipe and sleeve, except where otherwise indicated. Sleeves through concrete may be 20-gauge metal, fiber, or other approved material. Sleeves shall be accurately located on center with the piping and shall be securely fastened in place. Space between sleeves and the pipe shall be calked or sealed to ensure that the opening is secure against leaking.

### 3.1.3.3 Protective Coating for Underground Steel Fittings

Exterior surfaces of steel fittings for plastic pipe shall be thoroughly cleaned of foreign matter by wire brushing and solvent cleaning. Cleaned surfaces shall be primed before application of tape in accordance with recommendations of the tape manufacturer. Tape shall be pressure-sensitive organic plastic tape at least 0.1 mm thick. Tape shall be applied with a 50-percent overlap.

## 3.2 TESTING

3.2.1 Waste filtration system unit(s) shall be pressure tested with air, in accordance with the manufacturer's written instructions, both before and after backfilling.

3.2.2 Leak detection system shall be tested by a representative of the manufacturer and witnessed by the Contracting Officer.

3.2.3 Waste filtration system shall be placed into operation as a whole, each unit in accordance with the manufacturer's recommendations, and shall exhibit no leakage from any component part for 8 hours in succession before system will be accepted.

## 3.3 ACCEPTANCE

Waste filtration system will be accepted under the following conditions:

- a. System meets the requirements of this specification.
- b. System is operating at the performance levels specified in paragraphs "Applications," "Influent Characteristics," and "Performance" within 5 days of installation.

If the system is rejected, defective unit(s), equipment, piping, or ancillary equipment or appurtenances shall be removed and replaced, or removed and repaired, or repaired at the direction of the Contracting Officer and at no additional cost to the Government. Furthermore, every replaced or repaired item and the system as a whole shall be subject to any applicable test of this specification.

END OF SECTION

## SECTION 11304

## SEPTIC TANKS

## PART 1 GENERAL

## 1.1 APPLICABLE PUBLICATIONS

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.

## FEDERAL SPECIFICATIONS (FED. SPEC.)

RR-F-621 Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

WW-U-53I Unions, Pipe, Steel or Malleable Iron, Threaded Connections, 667 NT, 1,112 NT and 1,335 NT. WSP

## AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI) STANDARDS

ASTM A 48M (1994) Gray Iron Casting (Metric)

ASTM A 58-A88 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 181M (1995) Forgings, Carbon Steel, for General Purpose Piping

ASTM A 733 (1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

ASTM B 117 (1995) Operating Salt Spray (Fog) Apparatus

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Products

Material and Equipment shall be the Standard products of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

## 1.2.2 Prevention of Rust

Unless otherwise specified, surfaces of ferrous metal subject to corrosion shall be factory-painted with a rust inhibiting coating. After exposure to Salt Spray Test conforming to ASTM B 117 for 120 hours for interior and 500 hours for exterior use, coating shall show no signs of wrinkling, cracking, or loss of adherence, and the specimen shall show no signs of rust creep, go beyond 6 mm on either side of the scratch mark made.

## 1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

## 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 01330: SUBMITTAL PROCEDURES:

#### Drawings

Shop Drawings; FIO.

Shop Drawings shall include a complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts; catalog cuts; Drawings; and instructions necessary for installation. Shop drawings shall contain complete piping and wiring Drawings and schematic diagrams; equipment layout and anchorage; and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawing shall indicate clearances required for maintenance and operation.

#### Reports

Performance Test Reports; FIO.

Upon completion and testing of the installed system, test reports shall be submitted 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. Each test report shall indicate the final position of controls.

### 1.4 MATERIALS AND EQUIPMENT

All materials shall be resistant to the effects of sewage.

#### 1.4.1 Pipe

##### 1.4.1.1 Steel Pipe

Pipe shall be Black carbon steel, ASTM A 53, Type E or S, Grade A or B, Schedule 40.

#### 1.4.2 Steel Pipe Fittings

Steel Pipe fittings shall conform to the following:

##### 1.4.2.1 Threaded Fittings

Malleable iron, 667 NT, ANSI B16.3.

##### 1.4.2.2 Flanged Fittings

Carbon Steel, 667, ANSI B16.5, ASTM A 181.

##### 1.4.2.3 Nipples

ASTM A 733 and of the same material as the pipe supplied.

##### 1.4.2.4 Unions

Fed. Spec. WW-U-531.

#### 1.4.3 Septic Tanks

1.4.3.1 The septic tanks shall be reinforced concrete tanks with grate adjustment rings, Manhole castings and santees for inlet, outlet, overflow, and baffle waterways as indicated.

1.4.3.2 The tank shall be designed and constructed to AASHTO H20-44 loading

requirements for structural loading as specified in AASHTO Standard Specifications for Highway Bridges.

1.4.3.3 The tank shall be complete including bolt up assemblies, offset and tongue and groove joints, joint gaskets and appurtenances.

1.4.3.3.1 Bolt up devices shall be cast into the tank sections to facilitate field assembly.

1.4.3.3.2 Offset and T and G joints shall provide alignment during assembly as well as recess for gaskets and grout for water tight seal.

1.4.3.3.3 Joint gasket shall be continuous tape of vulcanized butyl rubber 2 inches wide and 8 mm thick.

1.4.3.3.4 Grout shall be non-shrink, quick setting cement. Deliver to the site in the site Manufacturer unopened bags.

1.4.3.3.5 Appurtenances shall be the tank manufacturer's standard including manhole grate adjustment rings, Manhole castings, anchors, and piping sleeves. Sleeves shall be equivalent to I.P.S. AC manhole adapters.

1.4.3.4 Lifting lugs or rings shall be provided for unloading and erection at the site.

1.4.3.5 prior to assembly, all tank components shall be inspected for quality and defects. Cracks, voids, scaling, chips, breaks, and other damage shall be cause for rejection unless field repair is acceptable to the Contracting Officer. Inspection at the factory prior to transport may be requested; however, acceptance at the factory will not supersede rejection of in-transit or installation damage.

1.4.3.6 A superintendent and a skilled labor, trained and employed by the tank manufacturer's shall direct installation of the holding tank.

#### 1.4.4 Manhole Frames and Covers

1.4.4.1 Cast-iron Frames and covers and Manhole adjustment rings shall conform to the Drawings in all essentials of design and to Fed. Spec. RR-F-621, type as suitable for the application, circular without vent holes. The frames and covers shall have a combination weight of not less than 1,780 NT. and shall conform to ASTM A48, class 20B.

#### 1.4.5 Submersible Pumps (Sump Pumps)

Submersible pumps (sump pumps) shall be as specified in Section 15400 PLUMBING, GENERAL PURPOSE.

### 1.5 EARTHWORK

Excavation and backfilling for piping, precast tank and pump station shall be as specified in Section 02221: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

END OF SECTION

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## SECTION 13083

## 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 (1994a) Carbon Structural Steel
- ASTM A 53 (1995a) 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 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 (1988) Zinc-Coated Steel Structural Wire Rope
- ASTM A 653 (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

## 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)

## SHEET METAL &amp; 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 (1995) 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. This facility shall be designed as being in seismic zone 2B; 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 and furnaces	Storage Tanks for Fuel and Water
Water Heaters	Steam, Water, Fuel and Gas Piping
Heat Exchangers	Filter Separators & Air Eliminators
Pumps with Motors	Switchgear
Light Fixtures	Unit Substations
Motor Control Centers	Transformers
Switchboards (Floor Mounted)	Storage Racks
Suspended Ceiling Assemblies	Ducts
Flash Tanks	Unit Heaters
Accumulator Tank	Exhaust and Return Fans

#### 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
- Fuel Piping Outside of Buildings
- All Water Supply Systems
- Storm and 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.

#### 1.2.5 Protection of Piping Against Earthquake Damage

Seismic protection of the piping system shall be provided in accordance with NFPA 13. Seismic protection shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes. Branch lines shall be equipped with sway braces at intervals not exceeding 9 m (30 ft).

#### 1.2.6 Pipes and Ducts Requiring No Special Seismic Restraints

Seismic restraints may be omitted from the following installations:

- a. All piping less than 38 mm (1-1/2 inches) inside diameter.
- b. Electrical conduit less than 64 mm (2-1/2 inches) inside diameter.
- c. Rectangular air handling ducts less than 0.37 square meters (4 square feet) in cross sectional area.
- d. Piping suspended by individual hangers 300 mm (12 inches) 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.

### 1.2.7 All Other Interior Piping, Conduit, and Ducts

Interior piping, conduit, and ducts not covered above shall be seismically protected in accordance with the provisions herein.

### 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:

#### Drawings

Bracing and Coupling; FIO.

Flexible Couplings or Joints; FIO

Resilient Vibration Isolation Devices; FIO

Lighting Fixtures in Buildings; FIO.

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; GA.

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 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 or S, Grade B.

e. Light gauge angles, less than 6 mm (1/4 inch) thickness, ASTM A 653.

### 2.1.3 Flexible Couplings

Flexible couplings shall have same pressure and temperature ratings as adjoining.

#### 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 10-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 arrangements shown. Provisions of this paragraph apply to all piping within a 1.5 m (5 foot) 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 (1/2 inch) 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

Not used.

### 3.3 FLEXIBLE COUPLINGS OR JOINTS

Not used.

### 3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls and exterior underground structures shall be sized as indicated on the drawings or shall provide clearance 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 one and one half times the diameter 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 in accordance with the requirements of Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.6 ANCHOR BOLTS

#### 3.6.1 Cast-In-Place

Floor or pad mounted equipment shall use either cast-in-place anchor bolts or chemically bonded if intended for that use, 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, Anchor Bolts

Max. Equip. Weight	Minimum Bolt Sizes (mm)†					
	Kg	Zone 4	Zone 3	Zone 2A	Zone 2B	Zone 1
225	13	13	13	13	13	13
450	13	13	13	13	13	13
2250	13	13	13	13	13	13
4500	13	13	13	13	13	13
9000	13	13	13	13	13	13
13500	16	13	13	13	13	13
22500	22	16	16	13	13	13
45000	††	††	16	16	22	13

Maximum Equipment Weight (Pounds)	Minimum Bolt Sizes (Inches)†				
	Zone 4	Zone 3	Zone 2A	Zone 2B	Zone 1
500	1/2	1/2	1/2	1/2	1/2
1,000	1/2	1/2	1/2	1/2	1/2
5,000	1/2	1/2	1/2	1/2	1/2
10,000	1/2	1/2	1/2	1/2	1/2
20,000	1/2	1/2	1/2	1/2	1/2
30,000	5/8	1/2	1/2	1/2	1/2
50,000	7/8	5/8	1/2	1/2	1/2

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 50 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 (3/8 inch) 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.

#### 3.6.3.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1.1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. 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 load; 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. (0.5 inches.)

#### 3.7.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on all floor- or slab-mounted equipment. These snubbers shall provide 6 mm (0.25 inches) free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

### 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 Section 15400 PLUMBING, GENERAL PURPOSE.

#### 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

Pipe Diameter	Std. Wgt. Steel Pipe - 40S		Ex. Strong Steel Pipe - 80S		Copper Tube Type L	
	†L(ft.)	††F(lbs.)	†L(ft.)	††F(lbs.)	†L(ft.)	††F(lbs.)
1	22	70	22	80	11	17
1-1/2	25	140	26	180	12	35
2	29	220	30	290	14	70
2-1/2	32	380	33	460	15	110
3	34	550	35	710	17	150
3-1/2	36	730	38	930	18	220
4	39	960	40	1,200	19	300
5	41	1,440	44	1,900	20	470
6	45	2,120	46	2,750	22	730
8	49	3,740	54	5,150	26	1,550
10	54	6,080	59	7,670	28	2,630
12	58	8,560	61	10,350	31	3,950

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 (2 x 2 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 (40 foot) 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 the drawings. 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 (10 foot) vertical intervals. For tubing, bracing shall be provided at no more than 1.2 m (4 foot) 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

Maximum length†	Allowable Load†
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Type	Size (millimeters)	(meters)	(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

Type	Size (Inches)	Maximum length† (Feet/Inches)	Allowable Load† (kips)
Angles	1-1/2 x 1-1/2 x 1/4	4-10	5.7
	2 x 2 x 1/4	6-6	7.8
	2-1/2 x 1-1/2 x 1/4	8-0	9.8
	3 x 2-1/2 x 1/4	8-10	10.8
	3 x 3 x 1/4	9-10	11.9
Rods	3/4	3-1	3.7
	7/8	3-8	5.0
Flat Bars	1-1/2 x 1/4	1-2	3.1
	2 x 1/4	1-2	4.1
	2 x 3/8	1-9	6.2
Pipes (40S)	1	7-0	4.1
	1-1/4	9-0	5.5
	1-1/2	10-4	6.6
	2	13-1	8.9

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 in accordance with Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.8.8 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 13 mm (1/2 inch) 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 appropriate Seismic Hazard Level and connection level.

### 3.9.2 Unbraced Ducts

Hangers for unbraced ducts shall be positively attached to the duct within 50 mm (2 inches) of the top of the duct with a minimum of two #10 sheet metal screws. Unbraced ducts shall be installed with a 150 mm (6 inch) 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 NOT USED

### 3.12 EQUIPMENT SWAY BRACING

#### 3.12.1 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 arranged as shown and secured at both ends with not less than 13 mm (1/2inch) 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 0.56 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.

#### 3.12.2 Floor or Pad Mounted Equipment

##### 3.12.2.1 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.

##### 3.12.2.2 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 4.44 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.

### 3.13 MISCELLANEOUS EQUIPMENT

#### 3.13.1 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 0.11 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

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Air-Handling Units  
Transformers  
Switch Boards and Switch Gears  
Motor Control Centers  
Free Standing Electric Motors  
Surge Tanks  
Filter Separators  
Air Elimination Tanks  
Fuel Quality Monitors

3.13.2 Not used

### 3.14 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

#### 3.14.1 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.

#### 3.14.2 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 (56 pounds) in weight and suspended or pendant-hung fixtures not over 10 kg (20 pounds) 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.

#### 3.14.3 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 (4 inch) boxes, 75 mm (3 inch) plaster rings, and fixture studs.

#### 3.14.4 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.

#### 3.14.5 Wall-Mounted Emergency Light Unit

Each wall-mounted emergency light unit shall be secured to remain in place during a seismic disturbance.

#### 3.14.6 Lateral Force

Light fixture bracing shall be designed to resist a lateral force of 0.56 times the fixture weight.

### 3.15 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:

#### 3.15.1 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 (120 pounds). (120 pounds.)) 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 30 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 (4.0 psf). (4.0 psf.) Exception: Ceiling areas of 13 square meters (144 square feet) or less surrounded by walls that connect directly to the structure above will be exempt from the lateral-load standards of this specification.

#### 3.15.2 Installation Requirements

Installation requirements shall be in accordance with ASTM E 580 except as follows:

##### 3.15.2.1 Vertical Support

Hanger wires supporting a maximum tributary ceiling area of 1.5 square meters (16 square feet) shall be a minimum of 10 gauge in diameter. The size of wires supporting a tributary ceiling area greater than 1.5 square meters (16 square feet) shall be substantiated by design calculations. Hanger attachment devices used in ceiling systems not exceeding 200 Pa (4 psf) shall be capable of supporting a minimum allowable load of 1.3 kN (300 pounds). Hanger attachment devices used in ceiling systems exceeding 200 Pa (4 psf) 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.

##### 3.15.2.2 Lateral Support

In lieu of the design criteria stated above, where ceiling loads do not exceed 200 Pa (4 psf), 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.

#### 3.15.3 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 (56 pounds) in weight and suspended and pendent-hung fixtures not over 10 kg (20 pounds) 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 (20 pounds) and that receive no tributary loading from ductwork may be positively attached to and supported by the ceiling runners.

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-01     | (1993) Aluminum Standards and Data  |
| AA SAS-30 | (1986) Aluminum Construction Manual Series -<br>Section 1 Specifications for Aluminum<br>Structures |

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

- |          |  |
|----------|--|
| AAMA 101 | (1993) Voluntary Specifications for Aluminum<br>and Poly (Vinyl Chloride) (PVC) Prime Windows<br>and Sliding Glass Doors |
|----------|--|

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- |             |  |
|-------------|--|
| AISC FCD-90 | (1990) AISC Quality Certification Program<br>Description   |
| AISC-S303   | (1992) Code of Standard Practice for Steel<br>Buildings and Bridges                                    |
| AISC-S335   | (1989) Specification for Structural Steel<br>Buildings - Allowable Stress Design and<br>Plastic Design |

## AMERICAN IRON AND STEEL INSTITUTE(AISI)

- |             |  |
|-------------|--|
| AISI SG-673 | (1987) Cold formed Steel Design Manual |
|-------------|--|

## AMERICAN SOCIETY OF CIVIL ENGINEERS(ASCE)

- |           |  |
|-----------|--|
| ASCE 7-95 | (1996) Minimum Design Loads for Buildings and<br>other structures. |
|-----------|--|

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |  |
|------------|--|
| ASTM A 36  | (1994a) Carbon Structural Steel  |
| ASTM A 446 | (1993) Steel Sheet, Zinc-Coated (Galvanized)<br>by the Hot-Dip Process, Structural (Physical)<br>Quality |
| ASTM A 463 | (1994) Steel Sheet, Aluminum-Coated by the<br>Hot-Dip Process  |
| ASTM A 570 | (1992; R 1993) Steel, Sheet and Strip,<br>Carbon, Hot-Rolled, Structural Quality                         |

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 792 (1993a) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements

ASTM B 117 (1994) Operating Salt Spray (Fog) Testing

ASTM B 209 (1993) Aluminum and Aluminum-Alloy Sheet and Plate

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 D 522 (1993a) Mandrel Bend Test of Attached Organic Coatings

ASTM D 523 (1989; R 1993) Specular Gloss

ASTM D 714 (1987; R 1994) Evaluating Degree of Blistering of Paint

ASTM D 968 (1993) Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM D 1308 (1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes

ASTM D 1654 (1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 2244 (1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates

ASTM D 2247 (1994) Testing Water Resistance of Coatings in 100 % Relative Humidity

ASTM D 2794 (1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

ASTM D 3359 (1995) Measuring Adhesion by Tape Test

ASTM D 4214 (1989) Evaluating the Degree of Chalking of Exterior Paint Films

ASTM E 96 (1994) Water Vapor Transmission of Materials

ASTM G 23 (1995) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-1013 (1993) Architectural Sheet Metal Manual

UNDERWRITERS LABORATORIES (UL)

UL 580 (1994; Rev thru Apr 1995) Tests for Uplift Resistance of Roof Assemblies

## 1.2 GENERAL

### 1.2.1 Building Configuration

The building shall have vertical walls and a single-slope roof. Roof slope shall be as indicated. Buildings shall be single-span structures with either rigid frames in both directions or braced frames in each direction or a combination of both systems.

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 paragraph

### 1.3.2 Load Combinations

#### 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 Roof Live Loads

The roof live loads shall be as specified in section 4 of ASCE 7-95

#### 1.3.1.3 Roof Snow Loads

The basic design roof snow loads shall be 1.5 Kpa (30 lb per sq foot) with an importance factor of 1.2.

#### 1.3.1.4 Wind Loads

Wind pressures shall be computed and applied in accordance with ASCE 7-95. The basic wind speed is 137 kilometers per hour (85 mph) (3 second gust; 10 meters (33 feet) above the ground); exposure category of C with an importance factor of 1.15. For roof panels the design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the appropriate factor of safety as follows:

- a. Single fastener in each connections: 3.0
- b. Two or more fasteners in each connections: 2.25

#### 1.3.1.5 Seismic Loads

Seismic loads shall be computed for seismic zone 2B in accordance with TM 809-10 using an importance factor of 1.25.

#### 1.3.2 Load Combinations

- a) Dead+Live +Snow
- b) Dead + Live + Snow + 50% Wind
- c) Dead + Live + Wind + 50% Snow
- d) Dead + Seismic
- e) Dead + Wind

#### 1.3.3 Foundation Requirements

Foundations shall be designed for an allowable soil bearing pressure of 145 kPa a minimum bottom of footing depth of 1050 mm below finish floor elevation or shallower if a base course is specified that is not susceptible to frost heave, 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.

#### 1.3.4 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 element is as stated in paragraph 1.3.5.

#### 1.3.5 Deflections

The deflection of the building frames shall be calculated from the combinations as stated in paragraph 1.3.2.

The maximum horizontal deflection allowable in any direction shall be limited to 1/200 of the height in any direction. The maximum permitted vertical deflection of the building frames shall be

limited to 1/360 of the height in any direction.

The maximum deflection for grits, purlins, siding and roofing shall be 1/180 of the distance between supports.

#### 1.3.6 Exterior Covering

Except as otherwise specified, steel covering shall be designed in accordance with AISI SG-673. Aluminum covering shall be designed in accordance with the AA-01. Section modulus and moment of inertia of aluminum sheet shall be determined for actual cross section dimensions by the conventional methods for actual design stresses and by effective width concept for deflection in accordance with AA SAS-30. 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 see sub section 1.3.5. 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. Panels thinner than 0.76 mm are not permitted for diaphragms used to resist seismic loads in Seismic Zones 2B. The methods for resisting lateral loads shall be cross-bracing, rigid frames, or wind columns.

#### 1.3.7 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.

#### 1.4 SUBMITTALS

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:

Data

Design Analysis; GA.

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.
- c. Snow loading on the roof with the additional loading due to drift included as appropriate.

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; GA.

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; GA.

Qualifications of the manufacturer, and qualifications and experience of the building erector.

#### Certificates

Metal Building Systems; FIO.

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; FIO.

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

Accessories; FIO.

One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof and Wall Covering; FIO.

One piece of each type and finish (exterior and interior) to be used, 250 mm long, full width. The sample for factory color finished covering shall be accompanied by certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish.

Fasteners; FIO.

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.

Insulation; FIO.

One piece of each type to be used, and descriptive data covering installation.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample, approximately 0.5 kg, and descriptive data.

#### 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. 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 (0.045 inch) minimum thickness. Aluminum-zinc coated steel shall conform to ASTM A 792, AZ 55 coating designation, 1.143 mm (0.045 inch) minimum thickness. Aluminum sheet shall conform to ASTM B 209, 0.813 mm (0.032 inch) minimum thickness. Holes for bolts shall be made in the shop.

## 2.3 ROOF AND WALL COVERING

Panels shall be either steel or aluminum and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope or the entire height of any unbroken wall surface. Width of sheets with interlocking ribs shall provide not less than 305 mm of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be square cut, except 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.

### 2.3.1 Roof Panels

Roof Panels shall have configurations for overlapping sheets. Roof deck assemblies shall be Class 90 as defined in UL 580. System for securing the roof covering to structural framing members shall be exposed, penetrating fastener type. Height of corrugation at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

### 2.3.2 Wall Panels

Wall panels shall have configurations for overlapping adjacent sheets. Wall covering shall be fastened to framework using exposed fasteners.

### 2.3.3 steel Covering

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 0.610 mm (0.024 inch) thick minimum, except that when the mid field of the roof is subject to design wind uplift pressures of 2.87 kPa or greater or the steel covering is used as a diaphragm the entire roof system shall have a minimum thickness of 0.762 mm (0.030 inch).

Prior to shipment, mill finish panels shall be treated with a passivating chemical and oiled to inhibit the formation of oxide corrosion products. Panels that have become wet during shipment but have not started to oxidize shall be dried, retreated, and re-oiled.

### 2.3.4 Aluminum Covering

Alloy conforming to ASTM B 209, temper as required for the forming operation, minimum 0.813 mm (0.032 inch) thick.

#### 2.3.6.1 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 a rating of 10 failure at scribe, as determined by ASTM D 1654.

#### 2.3.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522, the coating film shall show no evidence of fracturing to the naked eye.

### 2.3.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested a minimum of 1000 hours in accordance with ASTM G 23, using a Type EH apparatus with cycles of 60 minutes radiation and 60 minutes condensing humidity. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

### 2.3.6.4 Humidity Test

When subjected to a humidity cabinet in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

### 2.3.6.5 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 millimeters (mils), expressed in Newton meters, with no loss of adhesions.

### 2.3.6.6 Abrasion Resistant Test

When subjected to the falling sand test in accordance with ASTM D 968, the coating system shall withstand a minimum of 80 liters of sand before the appearance of the base metal. Finished roof surfaces shall have a specular gloss value of 10 or less at an angle of 85 degrees when measured in accordance with ASTM D 523.

### 2.3.6.8 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.

### 2.3.7 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 covering building finish. Molded closure strips shall be bituminous-saturated fiber, 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

Fasteners for steel wall and roof panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum wall and roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both

tensile and shear strength of not less than 3.34 kN 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. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be manufacturer's standard for the system provided.

#### 2.4.1 Screws

Screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

#### 2.4.2 End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not less than 4.8 mm and cap or nut for holding covering against the shoulder.

#### 2.4.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not less than 3.68 mm with a shank length of not less than 12.7 mm for fastening panels to steel and not less than 25.4 mm for fastening panels to concrete.

#### 2.4.4 Blind Rivets

Blind rivets shall be aluminum with 4.8 mm nominal diameter shank or stainless steel with 3.2 mm nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

#### 2.4.5 Bolts

Bolts shall be not less than 6.4 mm diameter, shouldered or plain shank as required, with proper nuts.

### 2.5 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be fabricated of aluminum, 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 (0.018 inch) for steel and 0.8128 mm (0.032 inch) for aluminum. 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 DOORS

#### 2.6.1 Hinged Doors

Hinged doors and frames shall conform to SDOI SDI-100, Type, Grade and size as indicated. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as scheduled on the drawings and as specified in Section 08700 BUILDERS' HARDWARE.

#### 2.7 WINDOWS

Windows shall be of aluminum in accordance with AAMA 101. Windows shall be of the type shown, furnished complete with operating and locking hardware, glazing, screened panels, weatherstripping, and framing and fasteners to properly install the windows.

## 2.8 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 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.

### 2.8.1 Blanket Insulation

Blanket insulation shall conform to ASTM C 553.

## 2.9 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

## 2.10 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.

## 2.11 VAPOR RETARDER

### 2.11.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 0.02 perm or less when tested in accordance with ASTM E 96. Facing shall be of reinforced foil with a vinyl finish. Facings and finishes shall be factory applied.

## 2.12 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; welding of aluminum shall conform to AA SAS-30. 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.

### 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.

#### 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. Spacing of fasteners shall present an orderly appearance and shall not exceed: 200 mm on center at end laps of covering, 305 mm on center at connection of covering to intermediate supports, 305 mm on center at side laps of roof coverings, and 450 mm on center at side laps of wall coverings except when otherwise approved. 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 13 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 305 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 meter maximum. Supports for downspouts shall be spaced according to manufacturer's recommendations.

#### 3.1.5 Doors and Windows

Doors and windows, 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 and windows shall be sealed according to manufacturer's recommendations to provide weathertight construction.

#### 3.1.6 Insulation Installation

Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

##### 3.1.6.1 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.

### 3.2 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 13202  
FUEL STORAGE 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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO-01 (1992; interim Specs 1993; 1994; 1995) Standard Specifications for Highway Bridges

## AMERICAN PETROLEUM INSTITUTE (API)

API Bull 1529 (1989; Errata June 1990; R 1994) Aviation Fueling Hose

API Publ 1581 (1989; R 1994; Addenda July 1995) Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators

API RP 1110 (1991) Pressure Testing of Liquid Petroleum Pipelines

API RP 1631 (1992) Interior Lining of Underground Storage Tanks

API Spec 5L (1995) Line Pipe

API Spec 6D (1994) Specification for Pipeline Valves (Gate, Plug, Ball, and Check Valves)

API Spec 6FA (1994) Specification for Fire Test for Valves

API Std 610 (1995) Centrifugal Pumps for General Refinery Service

## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT-2050 (1992; Supple) Recommended Practice SNT-TC-1A

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27 (1993) Steel Castings, Carbon, for General Application

ASTM A 36 (1994a) Carbon Structural Steel

ASTM A 53 (1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 167 (1993) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 181 (1995b) Forgings, Carbon Steel, for General-Purpose Piping

ASTM A 182 (1995b) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

ASTM A 193 (1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 194 (1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

ASTM A 216 (1993) Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

ASTM A 234 (1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A 276 (1995) Stainless and Heat-Resisting Steel Bars and Shapes

ASTM A 307 (1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 312 (1994b) Seamless and Welded Austenitic Stainless Steel Pipes

ASTM A 356 (1995) Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines

ASTM A 358 (1994a) Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service

ASTM A 403 (1995a) Wrought Austenitic Stainless Steel Piping Fittings

ASTM A 733 (1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

ASTM A 743 (1995) Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

ASTM B 26 (1995) Aluminum-Alloy Sand Castings

ASTM B 241 (1995a) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

ASTM B 345 (1995) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube for Gas and Oil Transmission and Distribution Piping Systems

ASTM B 687 (1995) Brass, Copper, and Chromium-Plated Pipe Nipples

ASTM C 33 (1993) Concrete Aggregates

ASTM D 229 (1991) Rigid Sheet and Plate Materials Used for Electrical Insulation

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 4021 (1992) Glass-Fiber-Reinforced Polyester Underground Petroleum Storage Tanks

ASTM E 94 (1993) Radiographic Testing

ASTM F 436 (1993) Hardened Steel Washers

ASTM F 1199 (1988; R 1993) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

ASTM F 1200 (1988; R 1993) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3 (1992) Malleable Iron Threaded Fittings

ASME B16.5 (1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged 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 B16.34 (1988) Valves - Flanged, Threaded, and Welding End

ASME B16.39 (1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

ASME B31.3 (1993; B31.3a; B31.3b; B31.3c) Chemical Plant and Petroleum Refinery Piping

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1 (1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX (1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203 (1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1 (1991) Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS A5.4 (1992) Stainless Steel Electrodes for Shielded Metal Arc Welding

AWS A5.10 (1992) Aluminum and Aluminum Alloy Bare Welding Rods and Electrodes

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-50696 (Basic) Reels, Static Discharge, Grounding, 50 and 75 Foot Cable Lengths

FEDERAL SPECIFICATIONS (FS)

FS VV-F-800 (Rev D; Am 2) Fuel Oil, Diesel

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY  
(MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and  
Manufacture

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application

MILITARY SPECIFICATIONS (MS)

MS MIL-G-3056 (Rev F; Am 2) Gasoline, Automotive, Combat

MS MIL-M-81380 (Rev C) Monitor, Contamination, Aviation Fuel Dispensing  
System

MS MIL-P-29206 (Rev A; Am 2) Pipe and Pipe Fittings, Glass Fiber Reinforced  
Plastic, for Liquid Petroleum Lines

MS MIL-T-83133 (Rev D) Turbine Fuel, Aviation, Kerosene Types, NATO F-34  
(JP-8) and NATO F-35

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0274 (1993) High Voltage Electrical Inspection of Pipeline  
Coatings Prior to Installation

NACE RP0169 (1992) Control of External Corrosion on Underground or  
Submerged Metallic Piping Systems

NACE RP0185 (1985) Extruded, Polyolefin Resin Coating Systems for  
Underground or Submerged Pipe

NACE RP0190 (1995) External Protective Coatings for Joints, Fittings,  
and Valves on Metallic Underground or Submerged Lines &  
Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts  
maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (1993) Flammable and Combustible Liquids

NFPA 30A (1993) Automobile and Marine Service Station Code

NFPA 70 (1996) National Electrical Code

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 6 (1994) Commercial Blast Cleaning

STEEL TANK INSTITUTE (STI)

STI ACT-100 (1991) Specification for External Corrosion Protection of  
FRP Composite Steel Underground Storage Tanks

- STI F911 (1993) Unitized Steel Aboveground Storage Tank Systems with Open Top Secondary Containment
- STI P3 (1993) Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks
- UNDERWRITERS LABORATORIES (UL)
- UL-06 (1994; Supple; Rev thru March 1996) Gas and Oil Equipment Directory
- UL 58 (1986; Rev thru Jul 1994) Steel Underground Tanks for Flammable and Combustible Liquids
- UL 87 (1995) Power-Operated Dispensing Devices for Petroleum Products
- UL 142 (1993; Rev Apr 1995) Steel Aboveground Tanks for Flammable and Combustible Liquids
- UL 330 (1978; Rev thru Feb 1984) Gasoline Hose
- UL 567 (1992) Pipe Connectors for Flammable and Combustible Liquids and LP-Gas
- UL 842 (1993; Rev Aug 95) Valves for Flammable Fluids
- UL 913 (1988; Errata Dec 1988) Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II, and III, Division I, Hazardous (Classified) Locations
- UL 1316 (1994) Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures
- UL 1615 (1993) Installation of Underground Petroleum Storage Systems
- UL 1746 (1993; Rev thru Apr 1995) External Corrosion Protection Systems for Steel Underground Storage Tanks
- UL 2085 (1994) Insulated Aboveground Tanks for Flammable and Combustible Liquids

## 1.2 SYSTEM DESCRIPTION

The work shall include the design, fabrication and installation of the entire fuel storage and dispensing type system in conformance with pertinent federal, state, and local code requirements. The completed installation shall conform to NFPA 30 and NFPA 30A as applicable.

## 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 01330 SUBMITTAL PROCEDURES:

Data

Fueling System; GA.

Manufacturer's standard catalog data, prior to the purchase or installation of the particular component, highlighted to show brand name, model number, size, options, performance charts and curves, etc., in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment.

Permitting; GA.

Six copies of all required federal, state, and local permits.

Registration; GA.

Required tank registration forms, 30 days after contract award, in order for the Contracting Officer's Representative to submit the forms to the regulatory agency.

Spare Parts Data; FIO

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 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, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Drawings

Fueling System; GA Detail drawings including a complete list of equipment and materials, including automatic fuel management units (FMU), specified in Section 13410. Detail drawings shall contain:

- (1) Complete piping and wiring drawings and schematic diagrams of the overall system.
- (2) Equipment layout and anchorage.
- (3) Clearances required for maintenance and operation.
- (4) Any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

Monitoring Systems; GA

Detail drawings of the monitoring system including a complete list of equipment and materials. Drawings shall contain:

- (1) An overview drawing which details the leak detection system operation.
- (2) An overview drawing which details the liquid level and setpoint monitoring.
- (3) Wiring schematics for each part of the fueling system. The schematics shall indicate each operating device along with their normal ranges of operating values (including pressures, temperatures, voltages, currents, speeds, etc.).
- (4) Single line diagrams of the system.
- (5) Panel layout along with panel mounting and support details.

Instructions

Installation; FIO

Manufacturer's installation instructions and procedures on all parts and equipment.

Framed Instructions; FIO

Framed instructions for posting, at least 2 weeks prior to construction completion.

Monitoring Systems; FIO

System diagrams for posting, at least 2 weeks prior to construction completion, including distance markings so that alarm indications can be correlated to leak location in plan view if a cable detection system is used. The diagrams shall include a piping and wiring display map with schematic diagrams from the leak detection system manufacturer. The diagrams shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer's Representative.

Schedules

Filter-Separator Factory Tests; FIO

A schedule, at least 2 weeks prior to the factory tests, which identifies the date, time, and location for the tests.

Air Elimination Vessel Factory Tests; FIO

A schedule, at least 2 weeks prior to the factory tests, which identifies the date, time, and location for the tests.

Tests; FIO

A letter, at least 10 working days in advance of each test, advising the Contracting Officer's Representative of the test. Individual letters shall be provided for each test specified herein.

Demonstrations; GA

A letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

Statements

Experience; GA

A letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed. The letter shall also provide evidence of prior manufacturer's training, state licensing, and other related information.

Welding; GA

A letter listing the qualifying procedures for each welder. The letter shall include supporting data such as test procedures used, what was tested to, etc., and a list of the names of all qualified welders and their identification symbols.

Radiographic Tests for Aviation Fuel Piping; GA A letter, prior to performing any radiographic pipe tests, identifying the commercial or testing laboratory responsible for performing the test. The letter shall define the laboratory's qualifications and previously related job experience.

**Verification of Dimensions; FIO**

A letter stating the date the site was visited and a listing of all discrepancies found.

**Fuel Supply; FIO**

A letter, at least 120 days prior to fuel delivery, stating the amount of fuel required for testing, flushing, cleaning, or startup of the system. The letter shall define the required dates of each fuel delivery necessary.

**Reports****Filter-Separator Factory Tests; GA**

Six copies of the report in bound letter-size booklets. Report shall certify compliance with the testing and qualification procedures defined in API Publ 1581. The report shall contain complete records of the tests including data sheets, performance curves, chronological test records, photographs, sample calculations, test procedures, and a description of the test apparatus. The report shall include color photographs of the sample elements before and after tests.

**Air Elimination Vessel Factory Tests; GA**

Six copies of the report in bound letter-size booklets. The report shall contain complete records of the tests including data sheets, chronological test records, photographs, sample calculations, test procedures, and a description of the test apparatus.

**Tests; GA**

Six copies of each test containing the information described below in bound letter-size booklets. Individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, the high level alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible.

- (1) The date the tests were performed.
- (2) A list of equipment used, with calibration certifications.
- (3) A copy of measurements taken.
- (4) The parameters to be verified.
- (5) The condition specified for the parameter.
- (6) The inspection results, signed, dated, and certified by the

installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance with the plans and specifications.

- (7) A description of adjustments performed.

**Samples**

System Flushing; FIO Fuel samples, prior to any flushing procedures, taken from the transfer piping, fueling loop supply and return piping, supply and return piping to the operating tanks, and product recovery piping downstream of the oil water separator. Each sample shall be clearly identified according to the location from which it was taken. The Contracting Officer's Representative will have a preliminary contamination test performed on the samples. The Government will be responsible for the expense of the test.

Flushing Acceptance; FIO.

Fuel samples, following flushing procedures but prior to cleaning, taken from the transfer piping, fueling loop supply and return piping, supply and return piping to the operating tanks, and product recovery piping downstream of the oil water separator. Each sample shall be clearly identified according to the location from which it was taken. The Contracting Officer's Representative will have a contamination test performed on the samples. The Government will be responsible for the expense of the test.

Cleaning Acceptance; GA.

Fuel samples, following cleaning procedures, taken from the transfer piping, fueling loop supply and return piping, supply and return piping to the operating tanks, and product recovery piping downstream of the oil water separator. Each sample shall be clearly identified according to the location from which it was taken. The Contracting Officer's Representative will have a contamination test performed on the samples. The Government will be responsible for the expense of the test.

Operation and Maintenance Manuals

Operation Manuals; GA

Six complete copies of operation manuals in bound letter-size booklets listing step-by-step procedures required for system startup, operation, and shutdown at least two weeks prior to the demonstrations. The manuals shall include the manufacturer's name, model number, service manual, a brief description of each piece of equipment, and the basic operating features of each piece of equipment. The manuals shall include procedures necessary for annual tightness testing of the storage tanks and secondary containment piping.

Maintenance Manuals; GA

Six complete copies of maintenance manuals in bound letter-size booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide at least 2 weeks prior to the demonstrations. The manuals shall include ~~piping, equipment layouts, and simplified wiring and control diagrams of the system as installed~~ procedures necessary for annual tightness testing of the storage tanks and inspection of all fuel pipe trenches.

#### 1.4 QUALIFICATIONS

##### 1.4.1 Experience

Each installation Contractor shall have successfully completed at least 3 projects of the same scope and the same size or larger within the last 8 years. Each installation Contractor shall demonstrate specific installation experience in regard to the specific system installation to be performed. Each installation Contractor shall have taken, if applicable, manufacturer's training courses on the installation of piping, leak detection, and tank management systems and meet the licensing requirements in the state.

#### 1.4.2 Welding

Welding shall be in accordance with qualifying procedures using performance qualified welders and welding operators. Welding tests shall be performed at the work site. Procedures and welders shall be qualified in accordance with ASME BPV IX. Each welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.

Radiographic piping inspectors shall have qualifications in accordance with ASNT-2050 or ASTM E 94.

#### 1.5 REGULATORY REQUIREMENTS

1.5.1 Permitting. Contractor shall obtain necessary permits in conjunction with the installation of belowground piping as required by federal, state, or local authority.

1.5.2 Registration. Contractor shall obtain and complete all required registration forms required by federal, state, and local authorities.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter. Materials used for equipment protection during shipment that are intended to dissolve during a hydrostatic flush using water shall not be used.

#### 1.7 PROJECT/SITE CONDITIONS

##### 1.7.1 Verification of Dimensions.

After becoming familiar with all details of the project, the Contractor shall verify dimensions in the field, and advise the Contracting Officer's Representative of any discrepancy before performing any work.

##### 1.7.2 Fuel Supply.

Fuel required for the flushing, cleaning, and testing of materials, equipment, piping, meters, pumps, instruments, etc., as specified in this section shall be provided by the Government. Fuel will be provided by tank trucks. The Government will furnish the tank trucks, operators, equipment, and services required for the tank truck operations. The Contractor shall provide the labor, equipment, appliances, and materials required for the flushing, cleaning, and testing operations. Systems shall not be flushed, cleaned, or tested with any fuel or liquid not intended for final system operation. Fuel used in the system shall remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government. See also paragraph 3.4, FLUSHING, CLEANING AND ADJUSTING.

##### 1.7.3 Safety Requirements.

Exposed moving parts, parts that produce high operating temperatures and pressures, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

#### PART 2 PRODUCTS

## 2.1 STANDARD PRODUCTS

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 satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year 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, manufacturer's 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 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations. The completed installation shall conform to the applicable requirements of NFPA 30 or NFPA 30A, as applicable.

## 2.2 NAMEPLATES

Parts and equipment specified herein shall have an attached nameplate to list the manufacturer's name, address, component type or style, model or serial number, catalog number, capacity or size, and the system which is controlled. Plates shall be durable and legible throughout equipment life and made of anodized aluminum or stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

## 2.3 ELECTRICAL WORK

Electrical equipment, motors, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical bonding of materials shall be performed in accordance with NFPA 70. The fuel piping system shall be bonded in metallic contact to provide electrical continuity to fixed and moving components for grounding the entire system. Jumpers shall be provided to overcome the insulating effects of gaskets, paints, or nonmetallic components. Minimum size ground conductor shall be Number 6, with single covered, flexible, stranded, copper conductor, Type RR-USE. Dielectric connections shall be provided where indicated and in each riser pipe for underground piping protected by impressed current.

## 2.4 MATERIALS IN CONTACT WITH FUEL

### 2.4.1 Fuels.

Galvanized materials (zinc coated) shall not be allowed in direct contact with any fuel. Materials which come in contact with ~~any~~ fuel shall be stainless steel, aluminum, carbon steel, interiorly coated carbon steel, or fiberglass. No brass, bronze, or other copper bearing alloys shall be used in contact with aviation fuel.

2.4.1.1 Motor Gasoline (Mogas). Mogas shall be in accordance with MS MIL-G-3056.

2.4.1.2 Diesel. Diesel shall be in accordance with FS VV-F-800.

2.4.1.3 JP-8. JP-8 fuel shall be in accordance with MS MIL-T-83133.

2.4.2 Gaskets. Gaskets shall be factory cut from one piece of material and be resistant to the effects of aviation hydrocarbon fuels.

2.4.2.1 Nitrile Butadiene (Buna-N) Buna-N material shall be in accordance with SAE AMS 3275A.

2.4.2.2 Acrylonitrile Butadiene Rubber (NBR) NBR material shall conform to SAE AMS 3275A.

## 2.5 ABOVEGROUND STORAGE TANK

### 2.5.1 Bulk Storage Tank.

Tank shall be constructed as specified in Section 13205 STEEL TANKS WITH FLOATING PANS AND FIXED ROOFS.

### 2.5.2 Skid-Mounted Tank (Tanks T-4 & T-5, and Product Recovery Tank).

Tank shall be constructed of single wall steel in accordance with NFPA 30, NFPA 30A, and UL 142. Tank shall be designed and manufactured for horizontal installation. Tank shall be mounted on the tank manufacturer's standard support skid. Skid shall span the entire length of the tank and shall separate the tank from the reinforced concrete slab by a minimum of 200 mm (8 inches). Tanks T-4 and T-5 shall be sized as indicated. Product recovery tank (PRT) shall be 1900 liter (500 gallon) minimum single wall steel above ground tank with a minimum of two 50mm ports and a vent opening. Tank walls shall be 12 gauge or heavier. PRT shall be provided with exterior ladder and a suction tube for remote pump-out. PRT dimensions shall not exceed 1250mm (49") diameter and 1900mm (75") length unless adequate access is coordinated with the precast tank vault manufacturer. Access shall not be less than 760mm (30") on at least three sides of the tank.

### ~~2.5.3~~2.1 Tank Exterior Protective Coating.

Tank exterior protective coating shall be in accordance with Section 09925.

### ~~2.5.4~~2.2 Tank Interior Protective Coating

Tank interior protective coating shall be provided with an interior protective coating in accordance with API RP 1631 from the tank bottom up to 1 m (3 feet) off the bottom of the skid mounted tanks. Bulk tank shall be provided with an interior protective coating in accordance with Section 13205 STEEL TANKS WITH FIXED ROOFS.

### ~~2.5.5~~2.3 Tank Manway

Tank shall be provided with a manway cover and an interior tank ladder. Tank manway shall have an internal diameter of 760 mm (30 inches) minimum Tank manway shall be provided with a matching flanged watertight manway cover. Manway covers shall be constructed of cast steel in accordance with ASTM A 27, grade 60-30 as a minimum. Interior tank ladder shall be constructed of either fiberglass or steel. If steel, the ladder shall be completely coated in the same fashion as the interior tank bottom coating. Ladder shall be connected to the top of the tank with pipe guides or slip bars to accommodate expansion of the two stringers.

### ~~2.5.6~~2.4 Tank Piping Penetrations.

The number and size of tank piping penetrations shall be provided as indicated. Nylon dielectric bushings shall be provided on all pipe connections to a tank. Pipe connections to a tank shall be through welded-in-place double tapered NPT couplings.

### ~~2.5.7~~2.5 Tank Cleanout and Gauge Connection.

Tank shall be provided with a combination cleanout and gauge connection. The connection shall consist of a 50 mm (2 inch) pipe extending downward through the top of the tank to within 75 mm (3 inches) of the tank bottom. The entire length of pipe inside the tank shall be provided with suitable lots at alternate locations. The top of the pipe shall be provided with a bronze top-seal type adapter with a corresponding locking type cap. Tank shall have an interior striker/impact plate attached directly under the cleanout and gauge connection. The striker/impact plate shall be a minimum of 6 mm (1/4 inch) in thickness, be larger in diameter than the tank penetration, and fit the

curvature of the tank bottom.

#### 2.5.8-2.6 Tank Atmospheric Venting.

Vent pipe shall be in accordance with NFPA 30, NFPA 30A, and UL 142. Vent pipe sizing shall be not less than 32 mm (1-1/4 inches) nominal inside diameter.

#### 2.5.9-2.7 Tank Emergency Venting.

Vent shall be the emergency venting, tank manway type designed to relieve at a 13.8 kPa (2 psig) pressure. Vent shall comply with NFPA 30. Each manway shall have a watertight, self-closing type manway cover.

#### 2.5.10-2.8 Tank Overfill Alarm System.

Tank shall be provided with an overfill alarm system. The system shall include a mechanically-actuated float actuator and an alarm panel. The alarm panel shall include an alarm light, an audible alarm, and reset capabilities. ~~The alarm panel shall be mounted adjacent to the tank as indicated.~~ The alarm panel shall initiate a minimum 70 decibel audible alarm when the liquid level within a tank reaches the 90 percent full level. The alarm system shall conform to the requirements of paragraph MONITORING SYSTEM.

#### 2.6 NOT USED

#### 2.7 TANK GAUGES

##### 2.7.1 Stick Gauge

Tank shall be provided with 2 stick gauges one graduated in m and mm the other in feet, inches, and eighths of an inch. Stick gauge shall be of wood and treated after graduating to prevent swelling or damage from the fuel being stored.

##### 2.7.2 Tank Calibration Charts.

Tank shall be furnished with 2 copies of calibrated charts which indicate the liquid contents in L (gallons) for each 3 mm (1/8 inch) of tank depth.

##### 2.7.3 Not Used

##### 2.7.4 Hydrostatic Tank Gauge System.

System shall be the dial type calibrated in Liters (gallons). Gauge shall be manually actuated using a built-in hand pump. The transmission line from the gauge to the tank shall be seamless copper tubing run in Schedule 80 PVC carrier pipe. The tank assembly (fittings, air bells, and tubing) shall be installed according to the gauge manufacturer's recommendations.

##### 2.7.5 Not Used

#### 2.8 ADAPTERS AND COUPLERS

##### 2.8.1 Not Used

Adapter shall be bronze and be fitted with a Buna-N or Viton gasket. Adapter shall be the API standard 75 mm (3 inch) size. Adapter shall provide a tight-fit connection to prevent vapor emissions during filling. Adapter shall have an internal spring loaded poppet which prevents vapor emissions from the storage tank when the locking cap is removed. The poppet shall open

immediately during tank fill. The poppet shall operate at a lower pressure/vacuum than the tank's pressure/vacuum relief vent in order for vapors to return to the delivery truck instead of exiting through the vent piping. The poppet, the poppet stem, and the poppet spring shall be stainless steel. The adapter shall be provided with a locking cap. The cap shall mate with the adapter and have a latching mechanism which provides a water tight seal. The cap shall provide some type of locking provision and be easily attachable and removable. The cap shall be attached to the tight-fit vapor recovery adapter by a 300 mm (12 inch) section of brass cable or fuel resistant rope.

#### 2.8.3 Not Used

#### 2.8.4 Dry-Break Coupler (Bulk Recieving).

Coupler shall be the API standard 100mm (4 inch) size. Coupler shall provide a tight-fit connection to prevent vapor emissions during fuel transfer. Coupler shall be compatible with the fuel product being handled and be a female connection. Seals within the coupler shall be Buna-N or Viton. Coupler shall have an internal manually operated shutoff valve. The valve shall have an external operating handle with the valve's position (open or close) clearly labeled. The internal valve shall not be capable of being manually opened unless the coupler is properly connected to a tank truck's tight-fit adapter.

The adapter shall be provided with a cap. The cap shall mate with the adapter and have a latching mechanism which provides a water tight seal. The cap shall provide some type of locking provision and be easily attachable and removable. The cap shall be attached to the tight-fit vapor recovery adapter by a 300 mm (12 inch) section of brass cable or fuel resistant rope.

#### 2.8.5 Pressure Fueling Nozzle (Bulk Issuing and Tracked Vehicle Issuing)

Nozzles shall conform to MS MIL-N-5877, Type D-2 or MS MIL-N-52747, Type I, Class A. Sizes shall be as indicated. Nozzles and nozzle components shall be compatible with the fuel to be handled. Nozzles shall be provided with an internal 60 mesh stainless steel strainer and a fuel sample connection tapping. Nozzles shall be provided with a compatible dry break quick disconnect coupler and actuator. Coupler shall allow for quick disconnect and reconnect of fueling nozzles with corresponding adapters. Coupler and adapter shall provide a positive, leakproof connection under constant or surge flow. Coupler shall be designed to prevent blowout of internal poppet.

### 2.9 VEHICLE DISPENSING UNIT ("RETAIL ISLAND")

Unit shall be a power-operated dispensing device and shall be in accordance with UL 87, except as modified herein. Unit shall be factory fabricated and include but not limited to a base, housing, pedestal, pressure-relief device, strainer, air eliminator, meter, valves as required, hose-nozzle valve, motor control, locking mechanism, emergency shutoff valve, filter, and electrical wiring. Unit shall contain an integral dispenser suction pump. Each unit shall include but not be limited to an accounting meter, product hoses and nozzles, and necessary electrical controls. Mogas unit shall feature vacuum assist vapor recovery. Dispensers shall be provided with an in-line (spin on) filter for sediment removal down to 10 mg/l or less.

#### 2.9.1 Accounting Meter and Display.

Meter shall be a positive displacement type in accordance with UL 87, except as modified herein. Meter output displays shall be an electronic lighted display, visual from both sides of the dispenser. Displays shall indicate the cost of fuel delivered in dollars per gallon, ~~and liter of fuel, the cost of fuel delivered,~~ the amount of fuel delivered in gallons, and the total amount of fuel delivered over the life of the unit. The manual adjustment for the cost per gallon ~~and liter~~ display shall

be located in a lockable housing.

#### 2.9.2 Product Hose

Hose shall conform to UL 330. Each hose shall be 4.6 m (15 feet) long, shall be resistant to the fuels to be handled, have static grounding, and remain flexible in temperatures as low as minus 40 degrees C. (F.) A breakaway coupling, leakproof and corrosion resistant, shall be installed into each product hose. Couplings shall automatically pull apart and shut off flow to prevent product spill and damage to the hose or dispenser in the event of a "drive-away".

#### 2.9.3 Nozzles

Nozzles shall be manually activated to start the fuel flow and have a latch-open device integral to the assembly. Nozzles shall be the automatic shutoff type. Nozzles shall be constructed of lightweight aluminum and be provided with a full hand insulator. Nozzles shall have an integral vapor valve and coaxial hose connections to allow Stage II vapor recovery with vacuum assist.

#### 2.9.4 Electrical Controls

The installation of electrical equipment at the dispensers, motors, and pump starter controllers shall be in compliance with Class 1, Group D hazardous location. Each dispenser outlet shall be provided with an operating lever for starting the pump through a pump starter controller. The pump starter controller shall be mounted adjacent to the power panel box. The power panel box shall be equipped with an external emergency pushbutton to shut off the power to all pump starter motor controllers and dispensers. The power panel box shall be in sight of the dispensers at the attendant building.

#### 2.9.5 Emergency Shutoff Valve

Valve shall meet the requirements of UL 842 and be compatible with the intended fuels to be handled. Valve shall provide complete shutoff of a fuel line in the event a dispenser is dislocated or overturned due to a sudden impact. Valve shall provide a secondary poppet to limit spillage from the dispenser after a knockdown or during installation.

#### 2.9.6 Dispenser Sump

Sump shall be installed under each dispensing unit as indicated. Each sump shall provide convenient service access to all piping components enclosed in the sump. Sump shall be constructed of fiberglass-reinforced plastic. Sump shall be chemically compatible with the fuel to be handled by the dispensing unit and any connecting piping. Sump shall prevent fuel from escaping to the soil and ground water from entering the sump. Sump shall provide a liquid-tight termination point for secondary containment ~~piping which allows for the anticipated expansion and contraction of the piping system.~~ Sump shall withstand maximum burial loads. Sump shall mount directly to the bottom of the dispensing unit with a centering ring or stabilizer bar to assure proper shearing action for the emergency shutoff valve.

#### 2.10 PUMPS

Pump shall conform to API Std 610, except as modified herein. Mechanical seals within the pump shall be Buna-N or Viton. Pump casing, ~~bearing housing, and impeller~~ shall be stainless steel ASTM A 743 GR CF8M or GR CA6NM close grained cast iron or aluminum ASTM A 356 GR T6. Pump bearing housing and impeller shall be stainless steel ASTM A 743 GR CF8M or GR Ca6NM or aluminum ASTM A 356 GR T6. Pump shaft shall be stainless steel ASTM A 276 Type 410 or 416. Pump baseplate shall be of cast iron construction. Internal pump components in direct contact with the fuel to be handled shall be of compatible construction. Pump assembly shall be statically and dynamically

balanced for all flow rates from no flow to 120 percent of design flow. Pump bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Pump shall be driven by an explosion-proof motor for Class I, Division 1, Group D hazardous locations as defined in NFPA 70. Pump shall be accessible for servicing without disturbing connecting piping. Pump control panel shall include on and off indication lights for each pump. The panel shall contain an adjustable control logic for pump operation in accordance with the indicated operation. The panel shall also have a manual override switch for each pump to allow for the activation or deactivation of each pump. Panel, except as modified herein, shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR.

#### 2.10.1 Vertical Can Type Pump

Pump shall be a multi-stage vertical centrifugal pump and extend inside the pump can. Pump and motor combination shall operate totally submerged in the product. Pump fuel inlets shall be horizontal. Pump mounting shall completely support both the weight and vibration of the pump. The unit shall be provided with a steel lifting lug capable of supporting the weight of the entire pump and motor assembly. Pump shall include a vertical solid shaft motor, base mounting flange, horizontal pump discharge, low net positive suction head (NPSH) first stage impellers, dynamic and thrust balancing of impellers, and a stainless steel one piece pump shaft. Pump shall be provided with flanged end piping connections.

### 2.11 SUPPLEMENTAL COMPONENTS

#### 2.11.1 Earthwork

Excavation and backfilling for piping shall be as specified in Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein. Backfill for FRP pipe shall be pea gravel or crushed stone. Backfill for steel pipe, aluminum pipe, and stainless steel pipe shall be pea gravel, crushed stone, or sand.

##### 2.11.1.1 Pea Gravel

Pea gravel shall be between 3 and 20 mm (1/8 and 3/4 inch) diameter.

##### 2.11.1.2 Crushed Stone

Crushed stone shall be between 3 and 13 mm (1/8 and 1/2 inch) in diameter in accordance with ASTM C 33.

##### 2.11.1.3 Sand

Sand shall be fine sand aggregate in accordance with ASTM C 33, washed and thoroughly dried, contain no more than 500 PPM chlorides, contain no more than 500 PPM sulfates, and have a pH greater than 7.

##### 2.11.2 Not Used

##### 2.11.3 Not Used

##### 2.11.4 Not Used

##### 2.11.5 Cathodic Protection.

Buried metallic components including pipe, anchors, conduit, etc., shall be provided with a cathodic protection system in accordance with Section 16642 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT).

## 2.11.6 Not Used

## 2.11.7 Electrically Isolating Gaskets for Flanges

Flanges shall be provided with an electrical insulating material of 1000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of the type of fuel to be handled. Gaskets shall be full face and be provided between flanges as indicated. Flanges shall have full surface 0.75 mm (0.03 inch) thick, spiral-wound mylar insulating sleeves between the bolts and the holes in the flanges. Bolts may have reduced shanks of a diameter not less than the diameter at the root of the threads. High-strength 3 mm (1/8 inch) thick phenolic insulating washers shall be provided next to the flanges with flat circular stainless steel washers over the insulating washers. Bolts shall be long enough to compensate for the insulating gaskets and stainless steel washers.

## 2.11.8 Not Used

## 2.11.9 Concrete Anchor Bolts

Concrete anchor bolts shall be group II, Type A, class 2 in accordance with ASTM A 307.

## 2.11.10 Bolts

Bolts shall be in accordance with ASTM A 193, Grade B8.

## 2.11.11 Nuts

Nuts shall be in accordance with ASTM A 194, Grade 8.

## 2.11.12 Washers

Washers shall be in accordance with ASTM F 436, flat circular stainless steel. Washers shall be provided under each bolt head and nut.

## 2.11.13 Exterior Coating of Miscellaneous Items

Steel surfaces to be externally coated or painted shall be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6 prior to the application of the coating. Exterior surfaces, other than stainless steel pipe and flexible connectors, which are not otherwise painted and do not require the application of an exterior coating, as well as all items supplied without factory-applied finish paint, not including primer only items, shall be painted as specified in Section 09900 PAINTING, GENERAL.

## 2.11.14 Buried Utility Tape.

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape shall be provided for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be provided in minimum 75 mm (3 inch) width rolls, color coded for the utility involved, with warning identification imprinted in bold black letters continuously and repeatedly over entire tape length. Permanent code and letter coloring shall be used which is unaffected by moisture and other substances contained in trench backfill material.

## 2.11.15 Underground Wiring.

Underground electrical wiring shall be enclosed in PVC coated conduit. Conduit shall be dielectrically isolated at any steel storage tank connection.

### 2.11.16 Corrosion Protection for Buried Pipe Sleeves.

Cast iron or ductile iron pipe sleeves shall have protective coating, a cathodic protection system, and joint bonding. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA ANSI/AWWA C105/A21.5. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves shall be furnished and set in their proper and permanent location. Joint between sleeve and concrete shall be properly sealed to prevent escape or entry of fuel or water. Sleeves shall be steel or cast-iron pipe. sleeves penetrate concrete, a groove 6 to 13 mm (1/4 to 1/2 inch) wide by 6 to 10 mm (1/4 to 3/8 inch) deep shall be formed in the concrete around the pipe. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. A waterproofing clamping flange shall be installed.

## 2.12 BULK FUELING

### 2.12.1 Truck Loading Arm Assemblies

Truck loading arm assemblies shall be standard commercial units. Each arm shall be as indicated. Adjacent arms that would otherwise interfere shall have crossover capability. The materials of construction of each arm shall be aluminum. Seals and gaskets in the assembly shall be Buna-N or Viton. The assembly shall be either counterweighted or spring balanced to allow easy handling of the assembly during operation. Each arm shall be provided with necessary swivel joints, boom assemblies, riser standpipe, dry-break coupler, and fueling hoses. Swivel joints shall be flanged and be capable of rotating 360 degrees. Welded swivel joints and welding of swivel joints to the pipe will not be permitted. Swivel joints shall be of the non-lubricated type with non-lubricated bearings. Each loading arm shall be provided with signage visible from the adjacent drive through lane, indicating fuel type and flow direction. Signs shall be constructed from 22 gauge galvanized steel plate, with 2" minimum black letters on yellow background. Over-all size of signs and optimum location for visibility shall meet the approval of the Contracting Officer. Hoses shall be provided as part of the bulk load transfer arm assembly, as indicated on Plate M-15, Detail B. Hoses shall be provided as indicated for bulk fuel issuing and receiving service.

### 2.12.2 Fueling Hose

Hose shall be in accordance with API Bull 1529, Grade 3, Type A or C, semi-hardwall. Hose shall be compatible with the specified fuel and withstand a working pressure of 2070 kPa (300 psig). Hose shall be constructed of braided synthetic cord surrounded by an interior rubber tube and an exterior rubber cover.

### 2.12.3 Meters

#### 2.12.3.1 Fuel Meter For Truck Fill Stand.

Meter shall be of the continuous duty, positive displacement, straight-through flow type, designed for outdoor installation. Meter shall be capable of handling diesel fuel, automotive gasoline, and aviation jet fuels at a flow rate of 22 L/s (350 gpm). Meter shall be constructed of either Type 304 or 316 stainless steel or 3003, 6061-T6, or 356-T6 aluminum alloy and be in

accordance with ASME BPV VIII Div 1. Meter shall be suitable for hydrostatic testing at 1900 kPa (275 psig). Meter shall be reversible and be capable of momentary overspeeding to 115 percent of maximum rated capacity without damage or impairment of accuracy. Pressure drop across a meter shall not exceed 35 kPa (5 psig) when operated at rated capacity. Meter shall be provided with 150 mm (6 inch) Class ~~300~~ 150 flanges in accordance with ASME B16.5. Meter shall be a manufacturer's standard commercial product. Meter shall be so designed and constructed as to prevent parts from working loose in service and permit easy accessibility for maintenance and service in the field. Meter shall be treated and painted in accordance with the manufacturer's standard practice. A leakproof drain shall be provided at the lowest point of the meter housing. Meter shall be equipped with an accuracy adjustment mechanism that will operate without change during the life of the meter, except by manual adjustment. Meter shall be factory calibrated. Manual adjustment of a meter shall be possible while under pressure without leakage or loss of product and without requiring disassembly other than removal of a cover plate. Meter shall be equipped with a digital readout register mounted on the meter housing. Meter register shall contain a seven-figure nonsetback totalizer and a five-figure setback flow indicator without the milliliter (tenth-of-gallon) indicator. Digits on a meter register shall be a minimum 20 mm (3/4 inch) in height. Meter error shall not exceed 0.1 percent for any one predetermined flow rate and accuracy setting. The maximum meter error shall not exceed 0.3 percent for any one given accuracy adjustment at any flow rate ranging from 2 to 38 L/s (30 to 600 gpm). Meter shall be provided with a remote counter (Pulse Module) and a digital to analog signal converter ~~capable of providing a~~ with 4-20 mA analog output signal for readout of the fuel flow rate.

#### 2.12.3.2 Fuel Meter For Tracked Vehicles.

Meter shall be as above, except as modified herein. Meter shall indicate the fuel flow rate in metric and english. ~~Meter shall be provided with overspeed protection.~~ If meter is not mounted in-line with the piping, then the Contractor shall provide an appropriate pedestal for mounting. Meter installation shall be in accordance with manufacturer's recommendations. Meter shall be capable of handling diesel fuel and aviation jet fuels at a flow rate of 4 L/s (65 gpm).

#### 2.12.4 Fuel Quality Monitor

Monitor shall be in accordance with MS MIL-M-81380, except as modified herein. Monitor shall have Type 304 or 316 stainless steel or Types 3003 or 6061-T6 aluminum alloys fabricated housing with flanged inlet and outlet, 2 gauge taps, an air release tap complete with automatic air eliminator, and a 20 mm (3/4 inch) drain valve. Fuel quality monitor elements shall also conform to MS MIL-M-81380 for test procedures and performance requirements, except elements shall be of the slow-closing, water-absorbing type. Piston type direct-reading pressure differential gauge shall be provided wherein the piston moves downward in a glass cylinder along a 0 to 210 kPa (0 to 30 psi) graduated scale; permanent set of the spring shall be clearly visible by the position of the piston when there is no differential pressure. One complete set of elements for each unit shall be provided along with a calibrated tag showing differential pressure versus fuel flow for clean and dirty elements. One complete spare set of elements for each unit shall be provided.

#### 2.12.5 Filter-Separator Unit

Unit shall be tested and qualified in accordance with the performance requirements of API Publ 1581, Group II, Class B except as modified herein.

##### 2.12.5.1 Housing Vessel

Unit shall be fabricated from carbon steel or aluminium and be internally coated in accordance with Section 09873 INTERIOR TANK COATING. Unit shall be

constructed and labeled in accordance with ASME BPV VIII Div 1. The housing shall be designed for a working pressure of 1030 kPa (150 psig). Unit shall be vertical, end-opening type with coalescers and separators mounted side-by-side. The head opening shall be equipped with a hinged or pivoting device to facilitate swinging the head to one side for servicing. The hinges or pivots shall support the head during servicing without distortion or misalignment. Swing-type bolts shall be used on main closures. Unit shall be provided with lifting eyes spaced to support the entire weight of the unit. The housing shall be provided with a 20 mm (3/4 inch) inlet compartment fuel drain plug. A hand hole access plate shall be provided in the inlet compartment. Gaskets and O-ring shall be Buna-N or Viton construction. Threaded base mounting adapters shall be provided for the coalescers. The separators shall be mounted on adapters with blunted "Vee" type knife edges.

#### 2.12.5.2 Legs

Unit shall be provided with 4 each 75 x 75 x 6 mm (3 x 3 x 1/4 inch) angle-shaped legs welded to the housing. Each leg shall be fitted with a 100 x 100 x 13 mm (4 x 4 x 1/2 inch) base plate.

#### 2.12.5.3 Inlet and Outlet Connections

The inlet and outlet connections shall be 150 mm (6 inch) nominal pipe size and be located parallel to each other as indicated. Both inlet and outlet shall be flanged end connections.

#### 2.12.5.4 Manual Drain Valve

Unit shall be equipped with a 20 mm (3/4 inch) stainless steel manual ball valve on a water and fuel drain line. The valve shall allow the drainage of water, fuel, and sediment from the unit by gravity.

#### 2.12.5.5 Sight Gauge

Unit shall be provided with a 13 mm (1/2 inch) clear liquid level gauge for observing the water accumulation in the sump. The gauge shall be equipped with nickel-copper alloy ball checks in both the upper and lower fittings, an upper and lower shutoff valve, and a bottom blowoff cock. The gauge shall contain a colored density sensitive ball.

#### 2.12.5.6 Automatic Air Eliminator and Pressure Relief Valve

Unit shall be provided with an angle pattern pressure relief valve on top of the unit to assure the design working pressure of the unit is never exceeded. An automatic air eliminator shall be installed on top of the unit to vent trapped air from within the vessel. The air eliminator shall release at pressures up to 1030 kPa (150 psi) with no fuel leakage. The air eliminator shall be provided with a nonreturn check valve feature, opening pressure of 7 kPa, (1 pound,) to prevent air from being drawn into the unit via the air eliminator.

#### 2.12.5.7 Sampling Connections

Sampling connections shall be provided at the inlet and outlet connections to the housing. Each sampling connection shall consist of a 6 mm (1/4 inch) sampling probe where the probe faces upstream; a ball valve; a quick disconnect coupling; and an aluminum dust cap. The sampling connections shall be capable of accepting a sampling kit for drawing the samples required to assure fuel quality.

#### 2.12.5.8 Spider Assembly

Unit shall be provided with a spider assembly to hold the coalescers and separators in position and to support against vibration. The method of stabilization shall assure an electrical bond between the spider and the vessel.

#### 2.12.5.9 Coalescer and Separator Cartridges

Unit shall be provided with coalescers and separators that have been qualified to the performance requirements of API Publ 1581, Group II, Class B. Separators shall be 200 mesh stainless steel and be coated on both sides with teflon. Coalescers shall have a minimum capacity of 5.7 mL/s per mm (2.27 gpm per inch) of length, and separators shall have a minimum capacity of 21.0 mL/s per mm (8.33 gpm per inch) of length.

#### 2.12.5.10 Differential Pressure Gauge

The unit housing shall be equipped with a direct-reading, piston type differential pressure gauge that measures the differential pressure across both coalescers and separators. The gauge shall consist of a spring-supported, corrosion resistant piston moving inside a glass cylinder. The cylinder shall have stainless steel end flanges with Viton O-ring seals. The high pressure inlet of the gauge shall have a 0.01 mm (10 micron) pleated paper filter and the low pressure connection shall have a fine mesh stainless steel strainer. The gauge shall have an operating pressure of 2070 kPa (300 psi) with a cylinder burst pressure of not less than 8270 kPa (1200 psi). Differential pressure range of the gauge through approximately 75 mm (3 inches) of piston movement shall be 0-210 kPa (0-30 psi) with an accuracy of plus or minus 3.5 kPa, (0.5 psi,) calibrated linearly with 7 kPa (1 psi) scale graduations. High and low pressure connections shall be 6 mm (1/4 inch) NPT female with a stainless steel bar stock valve at each connection. Construction of the gauge shall be such that a 3-valve manifold is not necessary. If only 1 bar stock valve is closed, the gauge shall not be damaged by up to 2070 kPa (300 psi) differential pressure in either direction. The differential pressure gauge shall be attached to the filter separator by a gauge panel.

#### 2.12.5.11 Filter-Separator Factory Tests

Factory tests shall be performed on a filter separator to demonstrate compliance with the testing and qualification procedures defined in API Publ 1581 for Group II, Class B filter separators. The tests shall be performed in the presence of a Government representative if deemed necessary by the Contracting Officer. The tests shall be on a full-scale test system in accordance API Publ 1581, except as modified herein. The test sample shall consist of a complete filter separator with coalescer and separator elements installed. Elements shall be representative of a production lot. The filter separator, coalescers, and separator screens shall be identified with the manufacturer's part number. Prior to performing Test Series 1, 2, and 3, the filter separator shall be subjected to a hydrostatic pressure of 1900 kPa (275 psig) per the requirements of ASME BPV VIII Div 1. The average free water content in a test set shall not exceed 10 parts per million and any single sample shall not exceed 15 parts per million.

#### 2.12.6 System Control Valves

Valves shall be single-seated, diaphragm actuated, pilot-controlled globe valves. Each shutoff valve shall be provided with a position indicator, a pilot circuit strainer, and pressure gauge quick-disconnect fittings located in the valve inlet, outlet, and cover. Service and adjustments to a valve shall be possible without removing the valve from the line. Portions of a valve coming in contact with fuel shall be compatible with the fuel and be of noncorrosive material. Valves shall have bodies, bonnets, and covers

constructed of stainless steel conforming to ASTM A 743, type 304 or type 316; or aluminum alloy conforming to ASTM B 26, types 3003, 6061-. Each valve shall have stainless steel stem and trim. Valves shall be suitable for a working pressure of 1900 kPa (275 psig) at 38 degrees C (100 degrees F) with a weatherproof housing. Valves shall be provided with flanged end connections. Seats, body seals, and stem seals shall be Buna-N.

#### 2.12.6.1 Truck and Tactical Vehicle Fill Stand Shutoff (Unloading) Valve

Valve shall be for single-stage fuel flow. Valve shall hydraulically maintain the downstream pressure to the valve indicated during flowing conditions. Valve shall be in complete coordination with the corresponding control station (i.e. deadman controls and grounding unit). Control of the shutoff valve shall be as defined under paragraph **Control Station**. Valve shall fail closed in the event of a failure of the valve's diaphragm or a malfunction with any of the control station equipment. Solenoids mounted on the valve shall be rated for Class I, Division I, Group D hazardous locations. The solenoid shall accommodate the specific control conditions of the system in which the valve is to be installed.

#### 2.12.6.2 Back Pressure Control Valve (BPCV)

Valve shall be capable of maintaining the upstream flow rate at the indicated pressure. Valve setpoint shall be factory adjusted within a minimum range of plus or minus 20 percent of the indicated setpoint. Functions shall be externally adjustable. Valve shall be provided with a stainless steel orifice plate integrally mounted at the inlet port of the valve. Stainless steel control piping shall be provided to allow sensing differential pressure across the orifice plate. Valve shall be provided with opening speed controllers which are adjustable from 2 to 30 seconds without affecting the closing of the valve. Speed controllers shall be field adjustable and factory set for 15 seconds. Valve shall be provided with a solenoid operated pilot control assembly. See Sequence of Operation, Drawing Plate M-4.

#### 2.12.6.3 Not Used

#### 2.12.6.4 Relief Valve

Valve shall be hydraulically operated and normally closed. Valve shall be capable of maintaining a constant upstream pressure regardless of the downstream demand. Valve shall have an angle or straight pattern as indicated. Valves shall be factory-set to open at the indicated pressure and be field adjustable. Valve setpoint shall be adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint. Each valve shall be provided with a stainless steel sight flow indicator which has flanged end connections. The sight flow indicator shall consist of a housing containing a rotating propeller that is visible through a glass observation port.

#### 2.12.6.5 Filter Separator Control Valve and Float Assembly

Valve shall be float-operated and normally opened. Valve shall be capable of maintaining the downstream flow rate at the indicated pressure. Valve shall be provided with a stainless steel orifice plate integrally mounted at the inlet port of the valve. Stainless steel control piping shall be provided to allow sensing differential pressure across the orifice plate. Valve shall be provided with a float-operated pilot control assembly. The float and float assembly shall be stainless steel. The movement span of the float shall be factory adjusted. The assembly shall be fitted into the filter separator housing sump. The float assembly shall control both the filter separator control valve and the automatic water drain valve. Float shall ride on the fuel-water interface inside the filter separator sump and have 3 stages of

operation. The stages of operation include:

(a) Stage I: With the float down, the filter separator control valve shall be open and the automatic water drain valve closed.

(b) Stage II: With the float at the intermediate level, the filter separator control valve shall remain open while the automatic water drain valve opens.

(c) Stage III: With the float at a high level, the filter separator control valve shall close while the automatic water drain valve remains open.

#### 2.12.6.6 Filter Separator Automatic Water Drain Valve

Valve shall be float operated and normally closed. The valve shall be the on/off type and work in conjunction with the float-operated pilot control assembly.

#### 2.12.6.7 Flow Control Valve (Fuel Receiving)

Valve shall be solenoid operated and normally closed. Valve shall be provided with backpressure control pilots for three speed operation, using a solenoid operated pilot control assembly. Valve shall be provided with a triple pressure control valve, solenoid selected with check feature and opening speed control. Valve shall be provided with a stainless steel orifice plate integrally mounted at the inlet port of the valve. Stainless steel control piping shall be provided to allow sensing differential pressure across the orifice plate. Three control pilots shall be provided. Pilot A shall be solenoid operated and set at a differential pressure corresponding with a flow rate of 38 L/s (600 gpm); pilot B shall be solenoid operated and set at a differential pressure corresponding with a flow rate of 19 L/s (300 gpm); pilot C shall not be solenoid operated and shall be set at a differential pressure corresponding with a flow rate of 10 L/s (150 gpm). Solenoid controls shall be explosion proof, direct acting 3-way type that operate as described in the Sequence of Operation. Solenoids shall have a manual actuator for operation without electric power. Back pressure control feature shall allow main valve modulation to maintain a constant pressure at the main valve inlet.

#### 2.12.6.8 High Liquid Level Control Valve

Each above ground bulk tank shall feature a high liquid level control valve as indicated and as specified in Section 13205 STEEL TANKS WITH FLOATING PANS AND FIXED ROOFS.

#### 2.12.7 Control Stations

Each tank truck unloading station shall be provided with a pump control start/stop station, an emergency "stop" pushbutton station, and a grounding unit. Each truck fill stand shall be provided with a pump control start/stop station, an emergency "stop" pushbutton station, a grounding unit, deadman control, and a truck overflow unit. Each tracked vehicle fill stand shall be provided with a pump control start/stop station, an emergency "stop" pushbutton station, a grounding unit, and deadman control as indicated. Electrical supply and electrical control equipment shall be suitable for Class I, Division 1, Group D locations, be intrinsically safe, be weather resistant and be in accordance with UL 913, NEMA 250, and NFPA 70. Mounting hardware shall be corrosion resistant.

##### 2.12.7.1 Pump Control Start/Stop Station

Station shall include a start pushbutton, a stop pushbutton, and red and green

indicating lights. The sequence of operation for the station shall be as indicated on the drawings. During activation, the start pushbutton shall maintain contact until deactivated by the stop pushbutton. The stop pushbutton shall maintain contact until deactivated by the start pushbutton.

#### 2.12.7.2 Automated Fuel Inventory System

Pump controls shall be interlocked for compatibility with the automated fuel inventory control system. See Section 13410 AUTOMATED FUEL MANAGEMENT SYSTEM.

#### 2.12.7.3 Grounding Unit

Unit shall provide continual verification that the frame of the tank truck is grounded (electrically bonded). At truck fill stands, the unit shall immediately close the corresponding truck fill stand shutoff valve if the ground is broken or if the monitoring circuitry fails. Unit shall include red and green status lamps and lockable bypass switch. The type of tank truck connection required shall be as indicated. Unit shall be provided a self winding reel and 9 m (30 feet) of cable, or length as indicated. The grounding reel station shall be in accordance with CID A-A-50696, Type II.

#### 2.12.7.4 Deadman Control

Deadman controls shall include a deadman handle and necessary hose or control wiring. Handle shall be constructed of aluminum with a smoothly polished finish. Handle shall contain a manually activated ON/OFF trigger. Each deadman control shall be provided with a self winding reel and 9 m (30 feet) of fuel sensing hose or retractable cable, or length as indicated. Fuel sensing hose shall be dual type with Buna-N or Viton tube, vertically braided textile body with fuel resistant neoprene cover with stainless steel fittings. Fuel flow through a fill stand shall not be capable unless the deadman handle is depressed. The fill stand control valve shall fail closed in the event of a malfunction with the deadman control.

#### 2.12.7.5 Truck Overfill Unit

Unit shall provide for truck overfill protection by continuously and automatically monitoring the liquid-level within the tank of a tank truck. Unit shall be the self-checking type. Unit shall immediately close the corresponding truck fill stand shutoff valve if an overfill (high liquid-level) condition exists. Unit shall be provided with red and green indicator lamps. The type of tank truck connection required shall be as indicated. Unit shall be provided a self winding reel and 9 m (30 feet) of cable. Unit connection may be combined with the grounding unit if applicable.

#### 2.12.7.6 Remote Emergency "Stop" Pushbutton Station

Station housing shall be a watertight, galvanized steel enclosure with a replaceable break glass front with hammer and an open bottom. The galvanized enclosure shall be painted red. Mounting hardware shall be corrosion resistant. An emergency pushbutton shall be mounted inside the station housing and shall be accessible through the replaceable break glass and front. Pushbutton shall be a single unit with a jumbo mushroom operator, 1-NC and 1-NO contact. Station shall be suitable for Class I, Division 1, Group D locations, be intrinsically safe, be weather resistant, and be in accordance with UL 913, NEMA 250, and NFPA 70. During activation, the pushbutton shall maintain contact until deactivated by a key release. A caution sign shall be mounted beside the emergency shutdown station, with red 50 mm (2 inch) letters stating "EMERGENCY SHUTDOWN". The sign shall have white background and be of noncorrosive construction.

#### 2.12.8 Relaxation Tank (Air Elimination Vessel)

Tank shall be in accordance with API RP 2003. Tank shall be fabricated from aluminum or internally epoxy coated carbon steel. Inlet and outlet flange size shall be 150mm (6"). Unit shall be constructed and labeled in accordance with ASME BPV VIII Div 1. Housing shall be designed for a working pressure of 0.62 MPa (90 psig). Tank shall be 900mm diameter minimum, 2438mm minimum in height. Tank shall have sight gauge, air eliminator, pressure relief valve, drain valve, high level shut-off switch, and internal baffling to prevent vortices. Provide pressure vacuum vent with adjustable maximum vacuum setting of 150mm Hg (32oz/sqin) and ½ oz/sqin pressure setting, with suitable pipe support. Pressure venting capacity shall be 42 L/x (5400 cubic foot per hour), vacuum at 39 L/s (5000 cubic foot per hour). Provide 1" 150psi flanged level sensing switch connections at heights of approx 584mm (23"), 1346mm (53"), and two at 1650mm (65"). Switch operation shall be as indicated and described in the sequence of operation. Switch shall be weatherproof explosion proof suitable for Class 1 Div I Group D, 120 volt, DPDT. Relaxation time at maximum flow rate of the system shall be a minimum 30 seconds from the last filter or monitor to the exit point in a tank that may contain air. Each tank shall be provided with an ASME pressure vessel seal.

### 2.13 Differential Pressure Transmitter

Transmitter shall consist of a bellows type pressure-sensing element and an indicating gauge and shall be capable of providing an analog two-wire electrical 4-20 milliamp signal directly proportional to the differential pressure across the corresponding venturi tube. Indicator accuracy shall be 0.5 percent of full scale and transmitter accuracy shall be 0.25 percent of pointer indication. Transmitter shall be provided with built-in pulsation damper and suitable over-range protection. Transmitter shall not require recalibration due to power outages. Transmitter shall be UL listed for Class 1, Division 1, Group D hazardous locations. Each transmitter shall be supplied with a factory assembled five-valve stainless steel manifold. Vent valves shall be furnished on upper ports of each transmitter. Differential pressure ranges shall be selected as necessary to operate in conjunction with corresponding venturi tubes. Transmitter shall be mounted and installed according to manufacturer's recommendations.

#### 2.13.1 Bellows Type Pressure Sensing Element

Bellows pressure sensing element shall operate on a differential in pressure of fuel and shall be dual opposed, liquid filled, rupture-proof type with bellows movement converted to rotation and transmitted by a torque tube. Displacement of bellows shall be 25 mL (1-1/2 cubic inches) for full scale travel. Bellows housing shall be stainless steel and shall have a rated working pressure of not less than 3.5 MPa. (500 psi.) Differential pressure ranges shall be selected as necessary to operate in conjunction with the associated venturi tube. During operating conditions the pointer shall be approximately in the mid-range of the gauge. Liquid used to fill the bellows shall be suitable for the expected minimum ambient temperature.

#### 2.13.2 Indicating Gauge

The indicating gauge shall be an indicating dial at least 150 mm (6 inches) in diameter with a weatherproof glass cover. The gauge shall be driven by the bellows unit. The case shall be finished with a weather resistant epoxy resin enamel. The indicating pointer shall traverse a 270 degree arc. The scales shall be graduated over the selected pressure ranges so that the flow rate can be accurately read in Liters per second (gallons per minute).

### ~~2.13 MONITORING SYSTEM~~

#### ~~2.13.1 Not Used~~

~~2.13.2 Not Used~~~~2.13.3 Below ground Piping System.~~

~~The leak detection equipment shall be compatible with each type of fuel to be handled. The leak detection system shall provide continuous integrity check on the status of each sensor's connections and wiring. The system shall feature a continuous statistical leak detection (CSLD) board. Normally open or normally closed nomenclature on the sensors will not be acceptable.~~

~~Below ground piping systems shall be continuously and automatically monitored by electronic capacitance type liquid sensors. Sensors shall be capable of distinguishing the difference between hydrocarbons and water. Sensors shall be intrinsically safe for use in a class 1, division 1, group D environment as defined by NFPA 70. Sensors shall have a probability of detection of 95 percent and a probability of false alarm of 5 percent. Sensors shall be compatible with the electronic monitoring panel. Sensors shall be provided and installed in accordance with manufacturer's recommendations. Underground piping shall be provided with a method for periodic line tightness testing. The system shall also monitor each vent, drain and valving pit for the presence of the fuel being handled as well as water.~~

~~2.13.4 Electronic Monitoring Panel~~

~~The system shall feature a continuous statistical leak detection (CSLD) board. The alarm panel shall be connected to each piping leak detection system and shall be capable of providing an audible and visual alarm in the event of a detected leak. The panel shall provide audible and visual alarms for any failed integrity check. The panel shall provide a means of delineating between individual alarm conditions. Panel shall be remotely mounted within the attendant building. Exact panel location shall be as approved by the Contracting Officer's Representative. Audible alarms shall be a buzzer sounding at 70 decibels or greater. Each visual alarm shall indicate the type and location of the alarm condition. Visual alarms shall be capable of delineating between individual alarm conditions. Panel shall provide a means of delineating between individual alarm conditions. Panel shall be housed in standard industrial enclosure. Panel shall have a hinged door to swing left or right (doors shall not swing up or down). Panel using computer memory shall be capable of maintaining current programmable information in the event of a power failure. Panel shall be provided with a manual acknowledge switch which shall be capable of deactivating the audible alarm. The acknowledge switch shall not be capable of deactivating subsequent audible alarms unless depressed manually again for each occurrence. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected. Switches shall be an integral component located on the front panel and be either a key switch or push button.~~

~~2.13.5 Line Tightness Testing~~

~~The monitoring system shall be capable of detecting a leak from any portion of the below grade product piping. Means shall be provided to allow for periodic line tightness testing by providing one of the following:~~

~~a. An automatic line leak detector, as specified above, which is also capable of detecting a minimum leak rate of 0.1 mL/s (0.1 gallons per hour) at 1-1/2 times the operating pressure on a monthly basis or;~~

~~b. An automatic line leak detector, as specified above, which is also capable of detecting a minimum leak rate of 0.08 mL/s (0.08 gallons per hour) at normal operating pressure on a monthly basis or;~~

~~e. A continuous and automatic system capable of monitoring the~~

~~interstitial space between the primary product piping and the exterior containment piping for product leaks.~~

## 2.14 PIPING COMPONENTS

### 2.14.1 Product Piping.

Piping routinely carrying fuel shall be carbon steel, interiorly coated carbon steel, FRP, stainless steel, or aluminum, or fiberglass, as defined herein. Pipe that is used to deliver JP-8 to bulk issue fueling points downstream of filter separators FS-1 and FS-2 shall be stainless steel.

### 2.14.2 Secondary Containment ~~Piping.~~

Piping carrying fuel within concrete trenches or buried ductile iron sleeves shall be readily accessible for inspection; as such the piping is considered aboveground. The sealed concrete trench itself comprises the secondary containment; double wall piping is not required for piping indicated inside pipe trenches. Any liquid collected in the trenches shall collect at the low points indicated. Joints in the precast secondary containment trench shall be sealed using the manufacturer's standard method to prevent liquid leakage into or out of the trench. Joints between precast trenches and pipe sleeves, precast sumps, or other components that make up the secondary containment system shall be sealed in accordance with manufacturer's recommendations using a product compatible with JP-8 fuel.

~~Buried piping carrying fuel shall be secondarily contained, unless otherwise indicated. Piping system shall be of either field built double wall construction with the internal pipe being the product pipe and the exterior pipe being a fiberglass reinforced plastic containment pipe, or factory built flexible double wall piping featuring stand off ribs formed during the fabrication process to create the interstitial space, and conforming to the requirements here in, may be used for pressurized fuel pipe size 50mm (2") diameter.~~

~~Piping system shall be a factory manufactured piping system designed in accordance with ASME B31.3 and NFPA 30. Field assembled containment piping shall allow for complete inspection of the product piping before the containment piping is sealed. Containment piping shall be chemically compatible with the type of fuel to be handled. Containment piping shall be non-corrosive, dielectric, non-biodegradable, and resistant to attack from microbial growth. Containment piping shall be capable of withstanding a minimum 35 kPa (5 psi) air pressure. Field assembled containment piping shall be evenly separated from the primary pipe using pipe supports which are designed based on pipe size, pipe and fuel weight, and operating conditions. The supports shall be constructed of FRP and shall be designed so that no point loading occurs on the primary or exterior pipe. Supports shall be permanently attached to the product pipe either by tack welding or by an adhesive. The piping and supports shall allow for drainage as well as the installation of any necessary leak detection equipment or cables. Supports shall be designed and installed to allow for pipe movement of both the product piping and the exterior piping without causing damage to either. Factory built double wall piping shall be installed in accordance with manufacturer's instructions and recommendations. Containment piping shall be capable of withstanding H-20 highway loading as defined by AASHTO 01. Connections shall accommodate the annular space of the pipe to allow for testing of the secondary containment.~~

### 2.14.3 Vent and Vapor Recovery Piping

Piping shall be single wall steel as defined herein.

#### 2.14.4 Steel Pipe

Carbon steel pipe shall be in accordance with ASTM A 53, Type E or S, Grade B, or API Spec 5L, seamless or electric-weld, Grade B. Pipe smaller than 65 mm (2-1/2 inches) shall be Schedule 80. ASTM A 53 pipe 65 mm (2-1/2 inches) and larger shall be Schedule 40. API Spec 5L pipe 65 mm (2-1/2 inches) and larger shall be Schedule 40S.

##### 2.14.4.1 Connections for Steel Pipe

Connections for pipe or fittings smaller than 65 mm (2-1/2 inches) shall be forged, socket weld type, 2000 W.O.G. conforming to ASTM A 182 and ASME

B16.11. Connections for pipe or fittings 65 mm (2-1/2 inches) and larger shall be butt weld type conforming to ASTM A 234, Grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe. Piping in inaccessible locations, such as product piping inside of piping sleeves that drain to the pipe trench, shall be welded. No threaded fittings shall be used for product piping in inaccessible locations, including locations inside the piping trenches. Fittings for leak detection probes serving the piping system shall accommodate the primary fuel pipe trench and leak detection cables, and any additional equipment required or recommended by the leak detector manufacturer.

#### 2.14.4.2 Welding Electrodes

Welding electrodes shall be E70XX low hydrogen type conforming to AWS A5.1 or AWS A5.4.

#### 2.14.4.3 Threaded Connections

Threaded connections shall only be used on piping 50 mm (2 inches) in nominal size or smaller and only where indicated. Connections shall be in accordance with ASME B16.3, Class 150. Threaded connections shall be sealed tightly with a thread sealant or lubricant which is compatible with the fuel to be handled.

#### 2.14.5 Fiberglass Reinforced Plastic (FRP) Pipe

##### 2.14.5.1 Pipe

Pipe shall be compatible with the fuel to be transported ~~handled~~ and be in accordance with MS MIL-P-29206. ~~Pipe shall be compatible with the fluid being transported.~~ Use of FRP piping is limited to direct buried service only and at pressures not exceeding that marked on the pipe.

##### 2.14.5.2 Fittings

Fittings and joining materials shall be in accordance with MS MIL-P-29206. ~~No threaded fittings shall be used for product piping in inaccessible locations. Fittings for secondary exterior pipe of double wall piping system shall accommodate the primary inner pipe and any additional equipment required, such as leak detection cables.~~ Fittings and joining materials shall be compatible with the fuel to be handled.

#### 2.14.6 Stainless Steel Pipe

Stainless steel pipe 150 mm (6 inches) or smaller shall be in accordance with ASTM A 312 Schedule 40, Type TP304L, seamless only. Stainless steel pipe 150 mm (6 inches) and larger shall be in accordance with ASTM A 312 Schedule 10S, Grade 304L, seamless only or ASTM A 358 Grade 304L, Class 1 or 3, welded with wall thickness no less than 6 mm (1/4 inch) for pipe 300 mm (12 inches) and smaller.

##### 2.14.6.1 Connections

Connections for pipe smaller than 65 mm (2-1/2 inches) shall be forged, socket weld type, Type 304 or 304L, 2000 W.O.G. conforming to ASTM A 182 and ASME B16.11. Connections for pipe 65 mm (2-1/2 inches) and larger shall be butt weld type conforming to ASTM A 403, Class WP, Type 304L, seamless or welded, and ASME B16.9 of the same wall thickness as the adjoining pipe. Piping in inaccessible locations, such as product piping inside of piping sleeves that drain to the pipe trench, shall be welded.

##### 2.14.6.2 Welding Process and Electrodes

The welding process for stainless steel piping shall be a gas tungsten arc or gas metal arc process in accordance with ASME B31.3. Welding electrodes shall be E308L conforming to AWS A5.4.

##### 2.14.7 Aluminum Pipe

Aluminum piping shall be in accordance with ASTM B 241 or ASTM B 345, alloy

6061-T6, Schedule 40 for pipe sizes 50 mm (2 inches) through 300 mm (12 inches); Schedule 80 for pipe sizes 50 mm (2 inches) and smaller.

#### 2.14.7.1 Connections for Aluminum Pipe

Socket welded connections shall be in accordance with ASME B16.11, except aluminum shall be alloy 5083-H112, alloy 6061-T6, or alloy 356-T6. Buttwelded connections shall be in accordance with ASME B16.9, except aluminum shall be in accordance with ASTM B 241, alloy 6061-T6, of the same weight as the pipe. Piping in inaccessible locations, such as product piping inside of piping sleeves that drain to the pipe trench, shall be welded.

#### 2.14.7.2 Aluminum Welding Process and Electrodes

The welding process for aluminum piping shall be a gas tungsten arc or gas metal arc process in accordance with ASME B31.3. Welding electrodes shall be ER5356 conforming to AWS A5.10.

#### 2.14.8 Valves

Portions of a valve coming in contact with fuel shall be compatible with the fuel to be handled. Valves shall have bodies, bonnets, and covers constructed of cast steel conforming to ASTM A 216, Grade WCB. Each valve shall have stainless steel stem and trim. Valves shall be suitable for a working pressure of 1900 kPa (275 psig) at 38 degrees C (100 degrees F) with a weatherproof housing and be provided with flanged end connections unless indicated otherwise. Seats, body seals, and stem seals shall be Viton or Buna-N.

##### 2.14.8.1 Gate

Valve shall be in accordance with API Spec 6D and conform to the fire test requirements of API Spec 6FA. Valve shall be of the flexible wedge disc type, conduit disc type, or double disc type. Valve shall be of the rising stem type with closed yoke, or the non-rising stem type equipped with a device to give positive visual indication of the valve's position.

##### 2.14.8.2 Swing Type Check.

Valve shall be swing type conforming to API Spec 6D regular type. Check valves shall be the tilting disc, non-slam type. Discs and seating rings shall be renewable without removing from the line. The disc shall be guided and controlled to contact the entire seating surface.

##### 2.14.8.3 Not Used.

2.14.8.4 Ball Valves 50 mm (2 inches) and larger shall conform to API Spec 6D. Valves smaller than 50 mm (2 inches) shall have one piece bodies and have a minimum bore not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. The ball shall be stainless steel. Valve shall be fire tested and qualified in accordance with API Spec 6FA. Valve shall be non-lubricated and operate from fully open to fully closed with 90 degree rotation of the ball. Where indicated, ball valves shall be full port type.

2.14.8.5 Plug (Double Block and Bleed) Valves. API SPEC 6D and MIL-V-12003 Type III, ANSI Class 150, nonlubricated, resilient, double seated, tapered lift, plug type capable of handling two-way shutoff; steel body, chrome-plated interior, and tapered plug of steel or ductile iron, chrome or nickel plated, with Buna-N seals. Valve design shall permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Valves shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves shall have weatherproof operators with mechanical position

indicators and a minimum bore size of 65 percent of nominal pipe size, unless the manufacturer can show an equivalent or greater flow rate with a lower percentage of internal cross sectional area.

#### 2.14.8.5.1 Valve Operation

Rotation of the handwheel toward open shall lift the plug without wiping the seals and retract the sealing slips so that clearance is maintained between the sealing slips and the valve body. Rotation of the handwheel toward closed shall lower the plug after the sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed, the slips shall form a secondary fire-safe metal-to-metal seat on both sides of the resilient seal.

#### 2.14.8.5.2 Relief Valves

ANSI Class 150, steel body. Provide plug valves with automatic thermal relief valves to relieve the pressure buildup in the internal body cavity when the plug valve is closed. Relief valves shall open at 25 psi differential pressure, and discharge to the throat of and to the upstream side of the plug valve.

#### 2.14.8.5.3 Bleed Valves

ANSI Class 150, steel body valve. Provide manually operated bleed valves that can be opened to verify that plug valves are not leaking when in the closed position. Provide discharge piping routed to the oil water separator.

#### 2.14.8.6 Globe

Valve shall conform to ASME B16.34.

#### 2.14.8.7 Pressure/Vacuum Vent Relief

Valve pressure and vacuum capacities shall be in accordance with NFPA 30. Valve shall be factory set for 10.3 kPa (1.5 psi) pressure and 860 Pa (2 ounces per square inch) vacuum for steel tanks. Pressure and vacuum relief shall be provided by a single valve. Valve shall be constructed of cast steel with flanged or threaded end connections. Trim shall be stainless steel. Inner valve pallet assemblies shall have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats. Pallet seat inserts shall be of a material compatible with the fuel specified to be stored.

#### 2.14.8.8 Butterfly with Fusible Link Operator

Valves shall be in accordance with API Std 609 and shall conform to the fire test requirements of API Std 607. Valves shall be designed for bubbletight bidirectional shutoff service at maximum pressure ratings. Stem seals shall be capable of withstanding the rated pressure and temperature of the valve seat. Valves shall be provided with a fusible link type valve operator. The fusible link and spring assembly shall close the valve automatically when the link material melts at 75 degrees C (165 degrees F) and lock the valve in the closed position. Spring assembly shall be fully enclosed to ensure safety. Lug mounting shall not be used.

#### 2.14.8.9 Butterfly Valves

Valves shall meet the performance requirements of MSS-SP-67. Valve materials shall be stainless steel or interior coated carbon steel. All wetted materials shall be compatible with jet fuel. Valves shall be in accordance with API 607 and API 609, and feature a bi-directional backup metal seat fire

seal. Valves shall feature a minimum  $C_v$  rating at the full open (90 degree) position of 830. Valves shall be 150 pound rated flange style and be factory tested at minimum 110 percent rated pressure. Lug mounting shall not be used. Manual valve handle actuators shall be weatherproof, and oriented to indicate position indication.

#### 2.14.9 Piping Accessories

##### 2.14.9.1 Not Used

##### 2.14.9.2 Flanges

Flanges installed on equipment, fittings, or pipe shall be Class 150 pound flanges which are rated in accordance with ASME B16.5. Flanges shall be the 1.6 mm (1/16 inch) raised face type, except for connections to FRP pipe. Connections to FRP pipe shall be made with flat face flanges. Stainless steel flanges shall conform to ASTM A 182. Aluminum flanges shall conform to ASTM A 182, alloy 6061-T6 or alloy 356-T6. Carbon steel flanges shall conform to ASTM A 181, Grade 2.

##### 2.14.9.3 Flange Gaskets

Flange gaskets shall be 1.6 mm (1/16 inch) thick, NBR, and be in accordance with ASME B16.21. Full-face gaskets shall be provided for flat-face flanged pipe joints. Ring gaskets shall be provided for raised-face flanged pipe joints.

##### 2.14.9.4 Steel Coupling

Coupling shall be in accordance with API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.

##### 2.14.9.5 Welded Nipple

Nipple shall be in accordance with ASTM A 733 or ASTM B 687 and of the same material as the product piping.

##### 2.14.9.6 Threaded Union

Threaded unions shall only be used on cast steel piping 50 mm (2 inches) in nominal size or smaller and only where indicated. Union shall be in accordance with ASME B16.39, Class 150.

##### 2.14.9.7 Joint Compound.

Joint compounds for any type of piping system shall be resistant to water and suitable for use with fuel containing 40 percent aromatics.

##### 2.14.9.8 Flexible Connector

Connectors shall conform to requirements of UL 567 and be the flexible metal hose, corrugated type with braided wire sheath covering. Connectors shall have close-pitch annular corrugations and be rated for a working pressure of at least 1900 kPa (275 psig) at 38 degrees C (100 degrees F). Connectors shall have a minimum 300 mm (12 inch) live length with flanged end connections. Metal for hose and braided wire sheath shall be stainless steel in accordance with ASTM A 167.

##### 2.14.9.9 Strainer

Strainer shall be in accordance with ASTM F 1199 or ASTM F 1200, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, as

indicated, and be the same size as the pipeline. Strainer body shall be fabricated of cast steel or Type 304 or 316 stainless steel with the bottom drilled and tapped. The body shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with a removable cover and sediment screen. Screen shall be 60 mesh wire screen with larger wire mesh reinforcement. Screen shall be 0.76 mm (22 gauge) stainless steel or Type 316 stainless steel. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

#### 2.14.9.10 Pipe Hangers and Supports.

Hangers and supports shall be of the adjustable type where indicated and conform to MSS SP-58 and MSS SP-69, except as modified herein. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dipped galvanized. Nuts, bolts, washers, and screws shall be Type 316 stainless steel when located under any pier. Miscellaneous metal shall be in accordance with ASTM A 36, standard mill finished structural steel shapes, hot-dipped galvanized.

a. Pipe Protection Shields. Shields shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Shields shall be provided at each slide type pipe hanger and support.

b. Low Friction Supports. Supports shall have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.05 mm (0.002 inch) under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Anti-friction material shall be a minimum of 2.3 mm (0.09 inch) thick. Steel supports shall be hot-dipped galvanized. Units shall be factory designed and manufactured.

#### 2.14.9.11 Exterior Coatings for Below-ground Steel Piping.

Steel Piping placed in direct contact with backfill or soil (such as vent piping) shall be provided with an exterior protective coating.

a. Pipe: Pipe shall receive protective coating system of factory-applied adhesive undercoat and continually extruded polyethylene coating conforming to NACE RP0185, Type A. The protective coating shall have a minimum thickness of 0.76 mm (30 mils).

b. Fittings and Other Surfaces: Fittings, couplings, regular surfaces, damaged areas of extruded polyethylene coating and existing piping affected by the **Contractor's** operations shall be protected by the application of polyethylene tape which conforms to NACE RP0169 and NACE RP0190, 0.76 mm (30 mils) nominal thickness. Surfaces to be tape wrapped shall be clean, dry, grease free, and primed with a compatible primer prior to application of tape. Primer shall be as recommended by the tape manufacturer and approved by the pipe coating manufacturer. Heat shrink sleeves may be provided in lieu of tape and shall overlap the pipe coating not less than 150 mm (6 inches).

c. Irregular Surfaces: Irregular surfaces shall be protected with a cold-applied liquid primer and heated coal-tar tape in accordance with AWWA C203.

#### 2.14.9.12 Exterior Coating for Aboveground Steel Piping.

Aboveground steel piping shall be painted as specified in Section 09900 PAINTING, GENERAL. Paint shall be rated for use on hot metal surfaces up to

230 degrees C (450 degrees F) and for surfaces exposed to the weather. Color of the finish coat shall match the Attendant Building.

#### 2.14.9.13 Pressure Gauge

Gauge shall conform to ASME B40.1. Gauge shall be single style pressure gauge for fuel with 115 mm (4-1/2 inch) dial, have aluminum case, bronze tube, stainless steel ball valve, pressure snubbers (pulsation damper), and scale range for the intended service, or as indicated. A ball valve shall be provided for each pressure gauge and gauge port. Gauges shall have all parts immersed in silicone oil.

#### 2.14.9.14 Flexible Ball Joints

Joints shall be carbon steel with polished steel balls capable of 360 degree rotation plus 15 degree angular flex movement, with flanged end connections. Joints shall be provided with pressure molded composition gaskets designed for continuous operation temperature of 135 degrees C (275 degrees F). Joints shall be designed for a minimum working pressure of 1.9 MPa (275 psig) at 38 degrees C (100 degrees F).

#### 2.14.9.15 Site Flow Indicator

Indicator shall be of stainless steel construction, be compatible with the fuel to be handled, and have flanged end connections. The sight flow indicator shall consist of a housing containing a rotating propeller that is visible through a tempered glass observation port.

### 2.15 MONITORING SYSTEM

2.15.1 Piping System. The monitoring system shall be capable of detecting a leak from each low point in the product piping secondary containment. The leak detection equipment shall be compatible with each type of fuel to be handled. The leak detection system shall provide continuous integrity check on the status of each sensor's connections and wiring. The system shall feature a continuous statistical leak detection (CSLD) board. Normally open or normally closed nomenclature on the sensors will not be acceptable. Piping systems shall be continuously and automatically monitored by electronic capacitance type liquid sensors. Sensors shall be capable of distinguishing the difference between hydrocarbons and water. Sensors shall be intrinsically safe for use in a class 1, division 1, group D environment as defined by NFPA 70. Sensors shall have a probability of detection of 95 percent and a probability of false alarm of 5 percent. Sensors shall be compatible with the electronic monitoring panel. Sensors shall be provided and installed in accordance with manufacturer's recommendations.

2.15.2 Above Ground Storage Tanks. The system shall monitor all above ground tanks, including the product recovery tank, for overfilling. Two bulk JP-8 tanks, one bulk diesel tank, one skid mounted diesel tank, one skid mounted mogas tank, one product recovery tank. Float actuator shall be mechanically actuated. The alarm panel shall initiate an audible alarm when the liquid level within a tank reaches the 90 percent full level. Each tank shall be identified both by an audible and a visual alarm in the event of an overfill at the monitoring panel.

2.15.3 Electronic Monitoring Panel. The system shall feature a continuous statistical leak detection (CSLD) board. The alarm panel shall be connected to each piping leak detection system and shall be capable of providing an audible and visual alarm in the event of a detected leak. The panel shall provide audible and visual alarms for any failed integrity check. The panel shall provide a means of delineating between individual alarm conditions. Panel shall be remotely-mounted within the attendant building. Exact panel

location shall be as approved by the Contracting Officer's Representative. Audible alarms shall be a buzzer sounding at 70 decibels or greater. Each visual alarm shall indicate the type and location of the alarm condition. Visual alarms in panel shall delineate between individual alarm conditions. Panel shall be housed in standard industrial enclosure. Panel doors shall be hinged to swing left or right. Panel using computer memory shall be capable of maintaining current programmable information in the event of a power failure. Panel shall be provided with a manual acknowledge switch which shall be capable of deactivating the audible alarm. The acknowledge switch shall not be capable of deactivating subsequent audible alarms unless depressed manually again for each occurrence. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected. Switches shall be an integral component located on the front panel and be either a key switch or push button.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Storage tanks shall be handled with extreme care to prevent damage during placement and shall be installed in accordance with the manufacturer's installation instructions and NFPA 30 or NFPA 30A, as applicable. The exterior surface of each tank shall be inspected for obvious visual damage prior to and proceeding the placement of each storage tank. Surface damage to a storage tank shall be corrected according manufacturer's requirements before proceeding with the system installation.

##### 3.1.1 Not Used

##### 3.1.2 Equipment

Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions. Supports shall be provided for equipment, appurtenances, and pipe as required. Floor-mounted pumps shall be provided with mechanical vibration isolators or a vibration isolation foundation. Anchors, bolts, nuts, washers, and screws shall be installed where required for securing the work in place. Sizes, types, and spacings of anchors and bolts not indicated or specified shall be as required for proper installation. Each dispenser and dispenser sump shall be installed in accordance with manufacturers' instructions. Dispensing units shall be isolated from the piping during flushing and cleaning operations.

##### 3.1.3 Piping

Piping shall be inspected, tested, and approved before burying, covering, or concealing. Piping shall be installed straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain toward the corresponding storage tank. Any pipe, fittings, or appurtenances found defective after installation shall be

replaced. Piping connections to equipment shall be as indicated or as required by the equipment manufacturer. Pipe and accessories shall be handled carefully to assure a sound, undamaged condition. The interior of the pipe shall be thoroughly cleaned of foreign matter and shall be kept clean during installation. The pipe shall not be laid in water or stored outside unprotected when weather conditions are unsuitable. When work is not in progress, open ends of pipe and fittings shall be securely closed so that water, earth, or other substances cannot enter the pipe or fittings. Cutting pipe, when necessary, shall be done without damage to the pipe. Pipe shall be reamed to true internal diameter after cutting to remove burrs. Changes in pipe sizes shall be made through tapered reducing pipe fittings. Stainless steel pipe shall in no case be welded directly to carbon steel pipe. Cutting of FRP pipe shall be performed with a hacksaw or circular saw. Fuel supply piping from a storage tank shall extend to within 150 mm (6 inches) of the tank's bottom.

#### 3.1.3.1 Aboveground Piping

Pipe sections shall be installed as indicated and be complete prior to performing any piping tests. FRP shall not be used aboveground.

#### 3.1.3.2 Belowground Piping

Nonmetallic pipe shall be installed in accordance with pipe manufacturer's instructions. Belowground piping shall be laid with a minimum pitch of 25 mm per 6m. (1 inch per 25 feet.) Horizontal sections of pipe shall be installed with a minimum of 450 mm (18 inches) of backfill between the top of the pipe and the ground surface. The full length of each section of belowground pipe shall rest solidly on the pipe bed. Joints in field assembled secondary piping shall not be made until inner pipe is successfully pressure tested.

#### 3.1.3.3 Pipe Hangers and Supports

Additional hangers and supports shall be installed for concentrated loads in piping between hangers and supports, such as for valves. Miscellaneous steel shapes as required shall be installed in accordance with ASTM A 36. Pipe supports shall be installed in accordance with MSS SP-58 and MSS SP-69. Pipe spacing shall be as follows:

Nominal Pipe Size (mm)	25 and Under	40	50	80	100	150	200	250	300
Maximum Hanger Spacing (m)	2.1	2.7	3	3.7	4.3	5.2	5.8	6.7	7.0
Nominal Pipe Size (Inches)	One and Under	1.5	2	3	4	6	8	10	12
Maximum Hanger Spacing (Feet)	7	9	10	12	14	17	19	22	23

#### 3.1.3.4 Pipe Sleeve

Piping passing through concrete or masonry construction shall be fitted with sleeves. Sleeve shall be of sufficient length to pass through the entire thickness of the associated structural member and be large enough to provide a minimum clear distance of 13 mm (1/2 inch) between the pipe and sleeve. Sleeves through concrete shall be 0.91 mm (20 gauge) steel, fiberglass, or other material as approved by the Contracting Officer's Representative. Sleeves shall be accurately located on center with the piping and securely fastened in place. The space between a sleeve and a pipe shall be caulked and

sealed as specified in Section 07920 JOINT SEALING. In fire walls and fire floors, caulk both ends of a pipe sleeve with UL listed fill, void, or cavity material.

#### 3.1.3.5 Pipe Anchor

Where steel piping is to be anchored, the pipe shall be welded to the structural steel member of the anchor and the abraded area shall be patched with protective coating or covering as specified.

#### 3.1.3.6 Exterior Coating for Belowground Steel Pipe

Except as otherwise specified, protective coatings shall be applied mechanically in a factory or field plant especially equipped for the purpose. Valves and fittings that cannot be coated and wrapped mechanically shall have the protective covering applied by hand, preferably at the plant that applies the covering to the pipe. Joints shall be coated and wrapped by hand. Hand coating and wrapping shall be done in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically. Piping installed in valve boxes or manholes shall also receive the specified protective coating.

a. Regular Surfaces, Fittings, and Couplings: Tape shall be initially stretched sufficiently to conform to the surface to which it is applied, using one layer lapped at least 25 mm (1 inch). Tape shall overlap the extruded polyethylene coated piping 75 mm (3 inches) at all joints. A second layer, lapped at least 25 mm (1 inch), with a tension as it comes off the roll shall be applied and pressed to conform to the shape of the component.

b. Damaged Areas of Extruded Polyethylene Coating: Residual material from coating shall be pressed into the break or trimmed off. Tape shall be applied spirally and one-half lapped as it is applied. Tape shall extend 75 mm (3 inches) beyond the damaged area. A double wrap of one full width of tape shall be applied at right angles to the pipe axis in a manner to seal each end of the spiral wrapping.

c. Existing Piping Affected by the Contractor's Operation: Pipe shall be wrapped to 75 mm (3 inches) beyond the point of connection.

#### 3.1.4 Buried Utility Tape

Bury tape with the printed side up at a depth of 300 mm (12 inches) below the top surface of earth or the top surface of the subgrade under pavements.

#### 3.1.5 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted and have identification markings applied as specified in Section 09900 PAINTING, GENERAL. Stainless steel and aluminum surfaces shall not be painted. Prior to any painting, surfaces shall be cleaned to remove dust, dirt, rust, oil, and grease.

#### 3.1.6 Framed Instructions

Framed instructions shall include equipment layout, wiring and control diagrams, piping, valves, control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The framed instructions shall be framed under glass or laminated plastic and be posted where directed by the Contracting Officer's Representative. The framed instructions shall be posted before acceptance testing of the system.

### 3.1.7 Start-Up Representative.

Manufacturer's field service representatives shall be provided at no additional cost to the Government to check each pump and control valve for proper installation prior to system flushing. Following the flushing and adjusting procedures, the service representatives shall also witness as a minimum the first two days of operation. Any additional time required due to delays or corrections by the Contractor shall be provided at no additional cost to the Government. The manufacturer's field service representative shall also instruct the required personnel in the proper operation and maintenance of the pumps and control valves.

## 3.2 EQUIPMENT TESTS

The facility shall be essentially complete. Fuel systems shall be complete and operable. All data including deficiencies encountered and corrective action taken shall be recorded. If a system cannot be adjusted to meet the design requirements, the Contractor shall promptly notify the Contracting Officer in writing.

### 3.2.1 Aboveground Storage Tank Tightness Tests.

A tightness test shall be performed on each skid mounted aboveground storage tank. The tests shall be performed prior to making piping connections. Tests shall be capable of detecting a 0.1 mL/s (0.1 gph) leak rate from any portion of the tank while accounting for effects of thermal expansion or contraction. Gauges used in the tightness tests shall have a scale with a maximum limit of 69 kPa (10 psig). Each storage tank shall be pressurized with air to 35 kPa (5 psig) and monitored for a drop in pressure over a 2-hour period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects. This pressure shall be maintained and soapsuds or equivalent material applied to the exterior of the tank. While applying the soapsuds, the entire tank shall be visually inspected, including the bottom surfaces, for leaks (bubble formations). Leaks discovered during either the 2-hour waiting period or the soapsuds tests shall be repaired in accordance with manufacturer's instructions. The pneumatic test shall be performed again in the event a leak is discovered.

### 3.2.3 Manufacturer's Tank Tests.

Following the tank tightness test, each storage tank shall be leak tested in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is more restrictive than the tightness tests already performed. Any test failure shall require corrective action and retest.

### 3.2.4 Not Used

### 3.2.5 Exterior Coating for Belowground Steel Piping.

The coating system shall be visually inspected for holes, voids, cracks, and other damage during installation. Damage to the protective coating incurred during transit and handling shall be repaired before installation. —Holidays in the protective coating shall be repaired immediately upon detection. Extreme care shall be taken in lifting the piping to perform the testing procedure. Chains or metal ropes shall not be used in lifting the pipe for testing. Labor, materials, and equipment necessary for conducting the tests shall be furnished by the Contractor.

### 3.2.6 Radiographic Tests for Fuel Piping.

Prior to the pneumatic and hydrostatic tests, product piping welds performed at the job site shall be examined randomly by radiographic tests as defined in Section 15052 WELDING PRESSURE PIPING. Procedures for radiographic testing shall be in accordance with ASNT-2050 or ASTM E 94. Interpretation of test results and limitations on imperfections in welds shall comply with the

requirements of "100 percent Radiography" as defined in ASME B31.3. Testing shall be performed by a qualified commercial or testing laboratory. Costs of testing, including retesting or repaired welds, shall be borne by the Contractor. Weld ripples or surface irregularities that might mask or be confused with the radiographic image of any objectionable defect shall be removed by grinding or other suitable mechanical means. The weld surface shall be merged smoothly with the base metal surface.

### 3.2.7 Piping Pneumatic and Hydrostatic Tests

Testing shall comply with the applicable requirements of ASME B31.3, NFPA 30, and the requirements specified herein. Care shall be taken not to exceed pressure rating of various fittings. Hydrostatic testing shall be performed using fuel as the liquid. Water shall not be introduced into the system for any testing. To facilitate the pneumatic and hydrostatic tests, various sections of the piping system may be isolated and tested separately. Where such sections terminate at flanged valve points, the line shall be closed by means of blind flanges in lieu of relying on the valve. Tapped flanges shall be provided to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Tapped flanges shall also be used for gauge connections. No taps in the permanent line will be permitted. Gauges shall be subject to testing and approval. In the event leaks are detected, the pipe shall be repaired and the test repeated. Following satisfactory completion of each pneumatic and hydrostatic test, the pressure shall be relieved and the pipe immediately sealed. Provision shall be made to prevent displacement of the piping during testing. Personnel shall be kept clear of the piping during pneumatic testing. Equipment such as pumps, tanks, and meters shall be isolated from the piping system during the testing.

#### 3.2.7.1 Pneumatic Procedures for Product and Vent\Vapor Piping

Piping to be installed underground shall not receive field applied covering at the joints or be covered by backfill until the piping has passed the pneumatic test described herein. A pneumatic test pressure shall be applied in increments. A preliminary 170 kPa (25 psig) test shall be applied. The pressure shall be maintained while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. Following the preliminary test, the piping shall be tested at a pressure of 340 kPa (50 psig) for not less than 2 hours, during which time there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. The pressure source shall be disconnected during the final test period. Any leaks revealed by the test shall be repaired and the test repeated.

#### 3.2.7.2 Pneumatic Procedures for Exterior Containment Piping

Exterior containment piping shall undergo a minimum pneumatic pressure of 35 kPa (5 psig). Pressure in secondary piping shall be maintained for at least 1 hour while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. This testing shall be in compliance with the manufacturer's published installation instructions.

#### 3.2.7.3 Hydrostatic Procedures for Product Piping

Upon completion of pneumatic testing and after backfilling, each piping system shall be hydrostatically tested with fuel at not more than 1900 kPa (275 psig) in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure for 4 hours. The Contractor shall furnish electricity, instruments, connecting devices, and personnel for the test. Fuel will be furnished by the Government. Care shall be taken to avoid accidental contamination of the fuel delivery vehicles during flushing. Defects in work

performed shall be corrected at the Contractor's expense, and the test repeated until the work is proven to be in compliance with the testing procedures. Any release of fuel (no matter the size) during testing shall be immediately contained, the pressure on the piping relieved, and the piping drained of fuel. The Contracting Officer's Representative shall be notified immediately of a fuel release, the exact location, an estimated quantity of release, and a discussion of the containment measures taken.

### 3.2.8 System Performance Tests

After all components of the system have been properly adjusted, the system shall be tested to demonstrate that the system meets the performance requirements for which it was designed. The maximum rated capacity of the system shall be tested by using several tank trucks simultaneously, if applicable. The use of tank trucks shall be coordinated with the Contracting Officer's Representative prior to testing. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is obtained from the Contracting Officer's Representative. The tests shall demonstrate the following:

- a. Each fuel pump delivers the indicated flow of fuel.
- b. The alarm and control panels are operational and perform as designed.
- c. Each fuel meter is operating accurately.
- d. Vent piping is clear of debris and each pressure/vacuum relief vent is operating properly.
- e. The vapor recovery system, bulk and retail, performs as designed.
- f. Each bulk dispensing unit is operational and performs as designed.
- g. Each tracked vehicle dispensing station is operational and performs as designed.
- h. Each truck loading and unloading arm assembly performs as designed. Each preset type meter, counter, by-pass valve, and truck fill stand shutoff valve operates as designed.
- i. Each emergency stop pushbutton station is capable of shutting down the entire fueling operation as designed.

### 3.2.9 High Liquid Level Alarm Test

Each storage tank shall be initially overfilled with the appropriate product in order to verify the high liquid level alarms in the remote alarm panel function as designed. The initial overfill shall also verify that the storage

tank overflow protection device functions as designed. Tank overflow shall stop immediately once the overflow device operates. The Contractor shall not overflow any storage more than 98 percent level even if the leak detection and liquid level electronic panel and the overflow device do not function as designed. Any problems with the electronic panel or the overflow device shall be corrected and retested. The system shall be drained below the high liquid levels following all tests.

#### 3.2.10 Operating Tank Low Level Alarm.

Valves shall be positioned to transfer fuel between operating tanks. One fueling pump shall be started and sufficient fuel shall be pumped out of the first operating tank to allow the low level alarm (LLA) to stop the fueling pump. This procedure shall be repeated for each fueling pump and each tank until the LLA stops the fueling pump due to the low liquid level in the operating tank.

#### 3.2.11 Fuel Delivery.

Flow rates at each direct fueling station shall be measured against various pressure fueling nozzle backpressures. Each timed flow rate period shall be at least 1 minute. False backpressure shall be created by throttling a valve downstream of the nozzle. The valve may be located on a tank truck or in an aircraft direct fueling station return line. The corresponding flow rates L/s (GPM) shall be recorded at pressure fueling nozzle pressures of 138 kPa (20 psig), 172 kPa (25 psig), and 241 kPa (35 psig). During the flow rate measurements, it shall be ensured that each temporary strainer has been removed, valves are fully open, pressure relief valves are not leaking and the differential pressure drop across each filter separator is within an acceptable range.

#### 3.2.12 Fueling Pump Operation.

Operation of pressure and flow devices to start and stop the fueling pumps at the indicated pressure and flow rates shall be demonstrated in the presence of the Contracting Officer's Representative. The operating sequence shall be repeated with each of the pumps being selected as the lead pump. For this test, the flow rates shall be measured and recorded.

#### 3.2.13 Emergency Shutdown

With one fueling pump circulating fuel through the system, each emergency stop pushbutton station shall be tested to verify that the pump stops and the emergency shutoff valve closes at the pushbutton station. The above procedure shall be repeated for each fueling pump. Tests for both the automatic and manual modes shall be conducted. A total emergency stop with three pumps running shall be simulated.

### 3.3 SYSTEM PERFORMANCE TESTS

Testing as performed under paragraph Equipment Tests shall be considered the initial system performance tests. They shall be performed following necessary system adjustments and calibrations to the various equipment and controls. Following the initial performance tests, final performance tests shall be done which involve the demonstration of the fueling system during actual fueling and defueling of a vehicle. The maximum rated capacity of the system shall be tested by using several vehicles simultaneously as applicable. The use of tracked vehicles and/or refueling trucks shall be coordinated with the Contracting Officer's Representative prior to testing. In the event a portion of the system or any piece of equipment fails to meet the test, the Contractor shall make the necessary repairs or adjustments and repeat the performance tests until satisfactory performance is obtained.

### 3.4 FLUSHING, CLEANING AND ADJUSTING

Following installation and equipment testing but prior to system performance testing, the following flushing, cleaning, and adjustments shall be performed.

### 3.4.1 Preparations for Flushing

#### 3.4.1.1 Initial System Cleaning.

The interior of each fuel storage tank shall be visually inspected and cleaned free of debris before filling. In the event of entry into a storage tank, the Contractor shall ensure a safe atmosphere exists. Contractor shall remove all preservatives and foreign matter from valves, line strainers, pumps, and other equipment coming in contact with fuel. No fuel will be delivered to the system until the Contractor has satisfactorily completed this initial system cleaning.

#### 3.4.1.2 Protection of Equipment

Temporary 40 mesh cone type strainers shall be installed in the suction line ahead of each fueling pump as well as ahead of each filter/separator. The strainers shall be constructed of the same material as the piping and shall be compatible with the fuel to be handled. The temporary strainers shall remain in place for a minimum of 4 days after system startup, after which time the Contractor shall remove the strainers and prepare the piping as intended for final system operation.

### 3.4.2 System Flushing

#### 3.4.2.1 Initial Fuel Supply

Fuel shall be provided in accordance with paragraph 1.7.2 Fuel Supply. Following the preparations for flushing, each storage tank shall be filled to a 25 percent capacity with the proper fuel according to the fueling system's final operational requirements. Following the initial fuel supply, each storage tank's fuel temperature and liquid level shall be measured and recorded. The liquid level shall be measured using a manual tank gauge.

#### 3.4.2.2 Vehicle Dispensing Unit (Retail Unit) Flushing

Fuel shall be pumped at the system's maximum design flow rate from a storage tank through the fuel supply piping, to the corresponding dispensing unit, and then into an empty fuel truck or tank as supplied by the Contracting Officer's Representative. Periodic samples for inspection by the Contracting Officer's Representative shall be taken during the flushing procedure. A minimum of 380L (100 gallons) shall be flushed through each dispensing unit's nozzle. The flushing procedure shall be continued until the fuel being delivered is acceptable to the Contracting Officer's Representative. Each dispensing unit shall be flushed in the exact same manner.

#### 3.4.2.3 Truck Fill Stand and Tracked Vehicle Island Flushing

Fuel shall be pumped at the system's maximum design flow rate from a storage tank through the fuel supply piping, to the corresponding truck or tracked vehicle fill stand, and then into an empty tank truck. Periodic samples for inspection by the Contracting Officer's Representative shall be taken from the drawoff connection of each truck fill riser while the corresponding tank truck is filling. When a tank truck has been filled, the operation shall be discontinued until the tank truck has returned the fuel to the storage tank from which it was taken. The empty tank truck shall then be returned to the truck or tracked vehicle fill stand and the flushing operation resumed. This procedure shall be repeated until the fuel being delivered is acceptable to

the Contracting Officer's Representative. Each truck fill stand shall be flushed in the exact same manner. During the flushing process, the strainer preceding the fueling meter shall be frequently cleaned.

#### 3.4.2.4 Disposal of Initial Fuel Supply

In the event the fuel contained in the piping system at the conclusion of the flushing operation is not considered by the Contracting Officer's Representative to be of satisfactory quality for the desired use, the Contractor shall be responsible for pumping out the entire fuel supply from the storage tanks and the piping system. The filter/separator and piping system shall be completely drained to the storage tank. Disposition of the fuel removed from the system shall be the responsibility of the ~~Government Contractor~~.

#### 3.4.3 Cleaning Equipment

Upon completion of flushing operations, permanent strainers shall be removed, cleaned, and reinstalled. If the pressure differential across the filter/separator elements exceeds that recommended by the manufacturer, the elements shall be replaced with the spare set furnished with the unit.

#### 3.4.4 Initial System Adjustments.

Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements. The Government will deliver enough fuel to the storage tanks to enable the Contractor to make final adjustments to equipment and controls. Flow rates and pressures shall be adjusted as required to meet the indicated requirements. The sequence of control for each component shall be adjusted to meet the indicated system requirements. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

#### 3.5 TRAINING

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer's Representative. The training period shall consist of a total of 40 hours of normal working time and shall start after the system is functionally completed but prior to final system acceptance. The field instructions shall cover all of the items contained in the operation and maintenance manuals as well as demonstrations of routine maintenance operations. Contractor shall make three training video tapes covering all operational aspects of the new facility, including safe fueling operations at each service island, fuel delivery operations, and overall maintenance requirements.

END OF SECTION

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## SECTION 13204

## COMMISSIONING OF FUELING SYSTEMS

## PART 1 GENERAL

## 1.1 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals with "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## Data

Commissioning Team; GA.

List of team members who will represent the Contractor in the pre-commissioning checks and functional performance testing, at least 2 weeks prior to the start of pre-commissioning checks. Proposed revision to the list, prior to the start of the impacted work.

## Instructions

Test Procedures; GA.

Detailed procedures for pre-commissioning checks and functional performance tests, at least 4 weeks prior to the start of pre-commissioning checks.

## Schedules

Test Schedule; GA.

Schedule for pre-commissioning checks and functional performance tests, at least 2 weeks prior to the start of pre-commissioning checks.

## Reports

Test Reports; GA.

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

## 1.2 SEQUENCING AND SCHEDULING

The work described in this Section shall begin only after all work required in related Sections, including Section 13202 FUEL STORAGE SYSTEMS, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 COMMISSIONING TEAM AND CHECKLISTS

The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein. In addition, the Government may be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
C	Contractor's Controls Representative
D (optional)	Design Agent's Representative
O (optional)	Contracting Officer's Representative
U (optional)	Using Agency's Representative

Each checklist shall be completed by the commissioning team. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

### 3.2 TESTS

The pre-commissioning check and functional performance test shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide the information required. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

3.2.1 Pre-Commissioning Checks. Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

3.2.2 Functional Performance Tests. Functional performance tests shall be performed for the items indicated on the checklist below. Functional performance test shall begin only after pre-commissioning check have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors.

3.2.3 Manufacturer's Support. Contractor shall retain the services of the manufacturer's representative for a minimum of two days during the testing and commissioning of the truck ground verification unit, the overfill prevention control unit, and the Automated Fuel Management System. Supplemental materials and equipment required for proper operation of the bulk fuel issue control stations shall be provided by the contractor as recommended by the manufacturer. The Contractor shall furnish all instruments and personnel required for the tests. A checklist shall be completed by both the Contractor and the system manufacturer as to the completeness and functionality of each system.

Pre-commissioning Checklist - Pumps**For Pumps: CP-1 and CP-2**

Checklist Item	Q	M	E	C	D	O	U
<b>Installation</b>							
a. Pump grouted in place.	___	___	X	X	___	___	___
b. Pump vibration isolation devices functional.	___	___	X	X	___	___	___
c. Pump/motor coupling alignment verified.	___	___	X	X	___	___	___
d. Piping system installed.	___	___	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	___	___	___
f. Pump not leaking.	___	___	X	X	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	___	___	___
h. Pressure/temperature gauges installed.	___	___	X	X	___	___	___
i. Piping system cleaned.	___	___	X	X	___	___	___
<b>Electrical</b>							
a. Power available to pump disconnect.	___	X	___	X	___	___	___
b. Pump rotation verified.	___	X	___	X	___	___	___
c. Control system interlocks functional.	___	X	___	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	X	___	___	___	___	___
e. Confirm shut-down of pumps upon release of any deadman handle at tactical island (retail pumps off).	___	___	___	___	___	___	___
f. Confirm shut-down of pumps upon release of any deadman handle at bulk island (retail pumps off).	___	___	___	___	___	___	___
g. Confirm shut-down of pumps upon release of deadman handle at tactical island with retail pumps in use.	___	___	___	___	___	___	___
h. Confirm shut-down of pumps upon release of deadman handle at bulk island with retail pumps in use.	___	___	___	___	___	___	___

Pre-commissioning Checklist - Pumps (Cont'd)**For Pump: CP-3**

Checklist Item	Q	M	E	C	D	O	U
<b>Installation</b>							
a. Pump grouted in place.	___	___	X	X	___	___	___
b. Pump vibration isolation devices functional.	___	___	X	X	___	___	___
c. Pump/motor coupling alignment verified.	___	___	X	X	___	___	___
d. Piping system installed.	___	___	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	___	___	___
f. Pump not leaking.	___	___	X	X	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	___	___	___
h. Pressure/temperature gauges installed.	___	___	X	X	___	___	___
i. Piping system cleaned.	___	___	X	X	___	___	___
<b>Electrical</b>							
a. Power available to pump disconnect.	___	X	___	X	___	___	___
b. Pump rotation verified.	___	X	___	X	___	___	___
c. Control system interlocks functional.	___	X	___	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	X	___	___	___	___	___
e. Confirm shut-down of pumps upon release of any deadman handle at tactical island (retail pumps off).	___	___	___	___	___	___	___
f. Confirm shut-down of pumps upon release of any deadman handle at bulk island (retail pumps off).	___	___	___	___	___	___	___
g. Confirm shut-down of pumps upon release of deadman handle at tactical island with retail pumps in use.	___	___	___	___	___	___	___
h. Confirm shut-down of pumps upon release of deadman handle at bulk island with retail pumps in use.	___	___	___	___	___	___	___

Pre-commissioning Checklist - Pumps (Cont'd)**For Pump: CP-4**

Checklist Item	Q	M	E	C	D	O	U
<b>Installation</b>							
a. Pump grouted in place.	___	___	X	X	___	___	___
b. Pump vibration isolation devices functional.	___	___	X	X	___	___	___
c. Pump/motor coupling alignment verified.	___	___	X	X	___	___	___
d. Piping system installed.	___	___	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	___	___	___
f. Pump not leaking.	___	___	X	X	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	___	___	___
h. Pressure/temperature gauges installed.	___	___	X	X	___	___	___
i. Piping system cleaned.	___	___	X	X	___	___	___
<b>Electrical</b>							
a. Power available to pump disconnect.	___	X	___	X	___	___	___
b. Pump rotation verified.	___	X	___	X	___	___	___
c. Control system interlocks functional.	___	X	___	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	X	___	___	___	___	___
e. Confirm shut-down of pumps upon release of any deadman handle at tactical island (retail pumps off).	___	___	___	___	___	___	___
f. Confirm shut-down of pumps upon release of any deadman handle at bulk island (retail pumps off).	___	___	___	___	___	___	___
g. Confirm shut-down of pumps upon release of deadman handle at tactical island with retail pumps in use.	___	___	___	___	___	___	___
h. Confirm shut-down of pumps upon release of deadman handle at bulk island with retail pumps in use.	___	___	___	___	___	___	___

Pre-commissioning Checklist - Misc Fuel Equipment**For Item:** \_\_\_\_\_

Complete for dispensers, meters, filter separators, transfer assemblies, air elimination vessels, and fuel quality monitors.

Checklist Item	Q	M	E	C	D	O	U
Installation							
a. Equipment grouted in place.	___	___	X	X	___	___	___
b. Vibration isolation devices installed as indicated and functional.	___	___	X	X	___	___	___
c. Adequate access to all parts for maintenance.	___	___	X	X	___	___	___
d. Corrosion resistant tags installed, completed, and visible.	___	___	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	___	___	___
f. Connections and appurtenances not leaking.	___	___	X	X	___	___	___
g. Associated field assembled components procured and installed in accordance with manufacturers' instructions.	___	___	X	X	___	___	___
h. Pressure/temperature/site gauges installed.	___	___	X	X	___	___	___
i. Drains/isolation valves/pressure relief valves/installed & adjusted.	___	___	X	X	___	___	___
j. Meters and measuring equipment calibrated.	___	___	X	X	___	___	___
Electrical							
a. Control system interlocks functional.	___	X	___	___	___	___	___
b. (Each dispenser) Verify that power disconnect is located within sight of the unit it controls.	___	X	___	___	___	___	___
b. Verify operation of emergency shut-down switch for any pump.	___	X	___	___	___	___	___

Pre-commissioning Checklist - Above Ground Tank Overfills

Complete for each of five above ground tanks and product recovery tank.

Checklist Item	Q	M	E	C	D	O	U
Installation							
a. Equipment bolted in place iaw mfr's recommendations.	___	___	X	X	___	___	___
b. Adequate access to all parts for maintenance.	___	___	X	X	___	___	___
c. Connections and appurtenances not leaking.	___	___	X	X	___	___	___
b. Associated field assembled components procured and installed in accordance with manufacturers' instructions.	___	___	X	X	___	___	___
c. Level measuring equipment calibrated and adjusted.	___	___	X	X	___	___	___
d. Level measuring equipment setpoints adjusted.	___	___	X	X	___	___	___
Electrical/Controls							
a. Control system interlocks function as specified or as recommended by the manufacturer.	___	X	___	___	___	___	___
b. Control system shuts down pump before tank level reaches 98% (or as specified) Demonstrate by operation or simulation.	___	X	___	___	___	___	___

Pre-commissioning Checklist - Bulk Truck Control Stations

Complete for all bulk fuel issuing and receiving points.

Checklist Item	Q	M	E	C	D	O	U
<b>Installation</b>							
a. Equipment bolted in place iaw mfr's recommendations.	___	___	X	X	___	___	___
b. Adequate access to all parts for maintenance.	___	___	X	X	___	___	___
a. Associated field assembled components (cables, deadman switch, etc) procured and installed in accordance with manufacturers' recommendations.	___	___	X	X	___	___	___
d. Receiving truck level sensing equipment is capable of shutting down pump due to overfill; (verify by operation or simulation to the satisfaction of the manufacturer.)	___	___	X	X	___	___	___
<b>Electrical/Controls</b>							
e. Control system bonding functions as specified and to the satisfaction of the manufacturer.	___	X	___	___	___	___	___
f. Control system shuts down pump before tank level reaches 98% (or as specified)	___	___	X	___	___	___	___
g. Control system shuts down pump and closes bulk loading valve due to loss of grounding or release of deadman handle. (verify by operation or simulation)	___	X	___	___	___	___	___
h. Control system shuts down pump and closes bulk loading valve due to system override created by automated fuel management system. (verify by operation or simulation)	___	X	___	___	___	___	___
i. Control system prevents pump start-up prior to approved access through the automated fuel management system. (verify by operation)	___	X	___	___	___	___	___
j. Control system closes bulk loading valve due to loss of grounding or release of deadman, if the retail dispensers are simultaneously issuing fuel. (verify by operation)	___	X	___	___	___	___	___

Pre-commissioning Checklist - (Fan Coil Unit)

For Packaged Terminal Air Conditioner (FCU-1):

Checklist Item	Q	M	E	T	C	D	O	U
<u>Installation</u>								
a. Vibration isolators installed.	___	___	X	X	X	___	___	
b. Access doors/removable panels are operable and sealed.	___	___	X	___	X	___	___	
c. Casing undamaged.	___	___	X	X	X	___	___	
d. Insulation undamaged.	___	___	X	X	X	___	___	
e. Condensate drainage is unobstructed.	___	___	X	X	X	___	___	
f. Fan belt adjusted.	___	___	X	___	X	___	___	
g. Damaged coil fins have been repaired.	___	___	X	___	X	___	___	
h. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	
<u>Electrical</u>								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	
b. Power available to unit control panel.	___	___	___	X	___	___	___	
c. Proper motor rotation verified.	___	___	___	___	X	___	___	
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	
e. Power available to electric heating coil.	___	___	___	X	X	___	___	
<u>Controls</u>								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	
b. Control valves/actuators operable.	___	___	X	X	___	___	___	
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	
<u>Testing, Adjusting, and Balancing (TAB)</u>								
a. Construction filters removed and replaced.	___	___	X	___	___	___	___	
b. TAB results +10%/-0% of L/s cfm shown on drawings	___	___	___	___	X	___	X	___
c. TAB Report submitted.	___	___	___	___	X	___	X	___

Pre-commissioning Checklist - (Unit Heater)

For Unit Heater:

Checklist Item	Q	M	E	T	C	D	O	U
<b>Installation</b>								
a. Air vent installed on hot water coil with shutoff valve as specified.	___	___	X	X	X	___	___	
b. Any damage to fins has been repaired.	___	___	X	___	X	___	___	
c. Manufacturer's required maintenance/operational clearance provided.	___	___	X	X	X	___	___	
<b>Electrical</b>								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	
b. Proper motor rotation verified.	___	___	___	X	X	___	___	
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	
d. Power available to electric heating coil.	___	___	___	X	___	___	___	
<b>Controls</b>								
a. Control valves properly installed.	___	___	X	___	___	___	___	
b. Control valves operable.	___	___	X	X	___	___	___	
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	
<b>Testing, Adjusting, and Balancing (TAB)</b>								
a. TAB Report submitted.	___	___	___	___	X	___	X	___

Pre-commissioning Checklist - (Exhaust Fan)

For Exhaust Fan:

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Fan belt adjusted.	___	___	X	___	X	___	___	___
Electrical								
a. Power available to fan disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control interlocks properly installed.	___	___	___	X	___	___	___	___
b. Control interlocks operable.	___	___	___	X	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB results +10%/-0% to L/s shown on drawings	___	___	X	___	X	___	___	___
b. TAB Report submitted.	___	___	X	___	X	___	___	___

Functional Performance Test Checklist - Pumps

**For Pumps: CP-1 & CP-2 (JP-8)**

1. Activate pump start using control system commands (all possible combination, on/auto, etc.).

CP-1: ON \_\_\_\_\_ AUTO \_\_\_\_\_ OFF \_\_\_\_\_  
 CP-2: ON \_\_\_\_\_ AUTO \_\_\_\_\_ OFF \_\_\_\_\_

a. Verify pressure drops across equipment upstream of pump:

		<u>CP-1</u>		<u>CP-2</u>
Strainer inlet pressure	_____	psig	_____	psig
Strainer outlet pressure	_____	psig	_____	psig

Verify pressure drop across strainer serving tracked vehicle island:

Strainer inlet pressure	_____	psig	_____	psig
Strainer outlet pressure	_____	psig	_____	psig

Verify pressure drop across strainer upstream of air elimination vessel:

Strainer inlet pressure	_____	psig	_____	psig
Strainer outlet pressure	_____	psig	_____	psig

Verify pressure drop across air elimination vessel:

Filter Sep inlet pressure	_____	psig	_____	psig
Filter Sep outlet pressure	_____	psig	_____	psig

Verify pressure drop across filter separator:

FQM inlet pressure	_____	psig	_____	psig
FQM outlet pressure	_____	psig	_____	psig

Verify pressure drop across fuel quality monitor:

Filter Sep inlet pressure	_____	psig	_____	psig
Filter Sep outlet pressure	_____	psig	_____	psig

b. Verify pump inlet/outlet pressure reading, pump design conditions, and pump manufacturer's performance.

DESIGN	ACTUAL
--------	--------

CP-1:

Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____

CP-2:

Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____

Functional Performance Test Checklist - Pumps (Cont'd)

c. Operate pump at minimum issue flow and at 100 percent of designed issue flow when all components are aligned for full flow fuel issue. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

Which above ground tank used: \_\_\_\_\_

Fuel level in above ground tank (tank shall be minimum 25% full):  
\_\_\_\_\_

<u>CP-1:</u>	MIN ISSUE	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____
Pressure readings at back pressure control valve (psi):	=====	_____
Pressure readings at farthest overhead bulk loader (psi):	_____	_____
Bulk loader flow rate (gpm):	_____	_____
Pressure readings at farthest tracked vehicle island (psi):	_____	_____
Tracked vehicle flow rate (gpm):	_____	_____

<u>CP-2:</u>	MIN ISSUE	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____
Pressure readings at back pressure control valve (psi):	_____	_____
Pressure readings at farthest overhead bulk loader (psi):	_____	_____
Bulk loader flow rate (gpm):	_____	_____
Pressure readings at farthest tracked vehicle island (psi):	_____	_____
Tracked vehicle flow rate (gpm):	_____	_____

Functional Performance Test Checklist - Pumps (Cont'd)

d. Operate pump at min receipt flow and at 100 percent of designed receipt flow (max flow through BPCV) when all components are aligned for full flow fuel receipt. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

Which above ground tank used: \_\_\_\_\_

Fuel level in above ground tank (tank shall be minimum 25% full):  
\_\_\_\_\_

<u>CP-1:</u>	MIN RECEIPT	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____
Pressure readings at back pressure control valve (psi):	_____	_____
Pressure readings at farthest air elimination vessel (psi):	_____	_____

<u>CP-2:</u>	MIN RECEIPT	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____
Pressure readings at back pressure control valve (psi):	_____	_____
Pressure readings at farthest air elimination vessel (psi):	_____	_____

e. Operate pump at shutoff or when all components are in full by-pass (recirc). Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

<u>CP-1:</u>	SHUTOFF
Pump inlet pressure (psig)	_____
Pump outlet pressure	_____
Pump flow rate (gpm)	_____

<u>CP-2:</u>	SHUTOFF
Pump inlet pressure (psig)	_____
Pump outlet pressure	_____
Pump flow rate (gpm)	_____

Functional Performance Test Checklist - Pumps (Cont'd)

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

CP-1:

Nameplate amperage \_\_\_\_\_

a. Full (Max) flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

CP-2:

Nameplate amperage \_\_\_\_\_

a. Full (Max) flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

\_\_\_\_\_  
\_\_\_\_\_

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

Functional Performance Test Checklist - Pumps (Cont'd)

**For Pump: CP-3 (Mogas)**

1. Activate pump start using control system commands (all possible combination, on/auto, etc.). ON \_\_\_\_\_ AUTO \_\_\_\_\_ OFF \_\_\_\_\_

a. Verify pressure drop across strainer upstream of pump:  
 Strainer inlet pressure \_\_\_\_\_ psig  
 Strainer outlet pressure \_\_\_\_\_ psig

Verify pressure drop across strainer upstream of air elimination vessel:  
 Strainer inlet pressure \_\_\_\_\_ psig  
 Strainer outlet pressure \_\_\_\_\_ psig

b. Verify pump inlet/outlet pressure reading, pump design conditions, and pump manufacturer's performance.

	DESIGN	ACTUAL
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are aligned for full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

SHUTOFF	100 percent		
Pump inlet pressure (psig)		_____	_____
Pump outlet pressure (psig)		_____	_____
Pump flow rate (gpm)		_____	_____

d. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

SHUTOFF	100 percent		
Pump inlet pressure (psig)		_____	_____
Pump outlet pressure		_____	_____
Pump flow rate (gpm)		_____	_____

Functional Performance Test Checklist - Pumps (Cont'd)

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____		_____
Voltage	_____		
Voltage to ground	_____	_____	_____

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____		_____
Voltage	_____		
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

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4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

Functional Performance Test Checklist - Pumps (Cont'd)**For Pump: CP-4 (Diesel)**

1. Activate pump start using control system commands (all possible combination, on/auto, etc.). ON \_\_\_\_\_ AUTO \_\_\_\_\_ OFF \_\_\_\_\_

a. Verify pressure drop across strainer upstream of pump:  
 Strainer inlet pressure \_\_\_\_\_ psig  
 Strainer outlet pressure \_\_\_\_\_ psig

Verify pressure drop across strainer serving tracked vehicle island:  
 Strainer inlet pressure \_\_\_\_\_ psig  
 Strainer outlet pressure \_\_\_\_\_ psig

Verify pressure drop across strainer upstream of air elimination vessel:  
 Strainer inlet pressure \_\_\_\_\_ psig  
 Strainer outlet pressure \_\_\_\_\_ psig

b. Verify pump inlet/outlet pressure reading, pump design conditions, and pump manufacturer's performance.

	DESIGN	ACTUAL
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are aligned for full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

SHUTOFF	100 percent	
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure (psig)	_____	_____
Pump flow rate (gpm)	_____	_____

d. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

SHUTOFF	100 percent	
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	
Voltage	_____		
Voltage to ground	_____	_____	_____

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	
Voltage	_____		
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

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4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

Functional Performance Test Checklist - Misc Fuel Equipment

**For Item:** \_\_\_\_\_

Complete for dispensers, meters, filter separators, transfer assemblies, air elimination vessels, and fuel quality monitors.

Functional Performance Test: Contractor shall demonstrate operation of all equipment noted above and as listed in the drawing schedules (Plate M-2), per drawings and specifications in accordance with the following:

- a. Check rated and actual flowrate (L/s) \_\_\_\_\_
- b. Check inlet and outlet sizes \_\_\_\_\_
- c. Note pressure differential across inlet and outlet. \_\_\_\_\_
- d. Note pressure differential across inlet and outlet as rated by manufacturer \_\_\_\_\_

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

Functional Performance Test Checklist - Above Ground Tank Overfill Sensors

Complete for each of five above ground tanks and product recovery tank.

1. Functional Performance Test: Contractor shall demonstrate operation of all overfill sensors and associated alarms, per drawings and specifications and in accordance with the Pre-commissioning Checklist - Above Ground Tank Overfill Sensors.

2. Certification: We the undersigned have witnessed the tests and certify that the item tested has met the requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing  
Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

Functional Performance Test Checklist - Bulk Truck Control Stations

Complete for all bulk fuel issuing and receiving points.

1. Functional Performance Test: Contractor shall demonstrate operation of all Control Stations, per drawings and specifications and in accordance with the Pre-commissioning Checklist - Bulk Truck Control Stations.

2. Certification: We the undersigned have witnessed the tests and certify that the item tested has met the requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative \_\_\_\_\_

Contractor's Mechanical Representative \_\_\_\_\_

Contractor's Electrical Representative \_\_\_\_\_

Contractor's Testing, Adjusting and Balancing  
Representative \_\_\_\_\_

Contractor's Controls Representative \_\_\_\_\_

Contracting Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

Functional Performance Test Checklist - Fan Coil Units

1. Functional Performance Test: Contractor shall demonstrate operation of fan coil as per specifications including the following:

Cooling/heating fan coils:

- (1) Verify fan coil unit response to room temperature set point adjustment. Changes to cooling set point to heating set point and return to cooling set point. \_\_\_\_\_
- (2) Check blower fan air flow. \_\_\_\_\_ L/s
- (3) Check cooling mode inlet air temperature. \_\_\_\_\_ degrees C
- (4) Check cooling mode outlet air temperature. \_\_\_\_\_ degrees C
- (5) Check heating coil water flow. \_\_\_\_\_ L/s
- (6) Check heating mode inlet air temperature. \_\_\_\_\_ degrees C
- (7) Check heating mode outlet air temperature. \_\_\_\_\_ degrees C

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

\_\_\_\_\_

Contractor's Mechanical Representative

\_\_\_\_\_

Contractor's Electrical Representative

\_\_\_\_\_

Contractor's Testing, Adjusting and Balancing

\_\_\_\_\_

Representative

Contractor's Controls Representative

\_\_\_\_\_

Contracting Officer's Representative

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Using Agency's Representative

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Functional Performance Test Checklist - Unit Heaters

The Contracting Officer will check unit heaters during the functional performance test.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters as per specifications including the following:

a. Verify unit heater response to room temperature set point adjustment. Changes to be heating set point to heating set point minus 10 degrees and return to heating set point. \_\_\_\_\_

b. Check blower fan speed. \_\_\_\_\_rpm

c. Check heating mode inlet air temperature. \_\_\_\_\_ degrees C  
Check heating mode inlet air temperature. \_\_\_\_\_ degrees F

d. Check heating mode outlet air temperature. \_\_\_\_\_ degrees C  
Check heating mode outlet air temperature. \_\_\_\_\_ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

\_\_\_\_\_

Contractor's Mechanical Representative

\_\_\_\_\_

Contractor's Electrical Representative

\_\_\_\_\_

Contractor's Testing, Adjusting and Balancing

\_\_\_\_\_  
Representative

Contractor's Controls Representative

\_\_\_\_\_

Contracting Officer's Representative

\_\_\_\_\_

Using Agency's Representative

\_\_\_\_\_

END OF SECTION



## SECTION 13205

STEEL TANKS WITH FLOATING PANS AND FIXED ROOFS

## 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 PETROLEUM INSTITUTE (API)

API SPEC 6D	(1994) Pipeline Valves (Gate, Plug, Ball, and Check Valves)
API STD 650	1988 (R 1990) (Addendum 1992) Welded Steel Tanks for Oil Storage
API STD 2000	1992 Venting Atmospheric and Low-Pressure Storage Tanks (Nonrefrigerated and Refrigerated)
API PUBL 2009	1988 Safe Welding and Cutting Practices in Refineries, Gas Plants, and Petrochemical Plants
API STD 2550	1965 (R 1992) Measurement and Calibration of Upright Cylindrical Tanks

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPV IX	(1992; Addenda Dec 1993) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME/ANSI B16.5	1988 (Errata 1988) (Addenda 1992) Pipe Flanges and Flanged Fittings
ASME/ANSI 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 B31.3	(1993; B31.3a) Chemical Plant and Petroleum Refinery Piping

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1993) Structural Steel
ASTM A 53	(1993) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 131	(1993) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 176	(1993a) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 182/A 182M	1992 (Rev. A) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

ASTM A 193/A 193M	1992 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	1992 (Rev. A) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 216/A 216M	(1993) Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 240	(1993b) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 269	(1994; Rev. A) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 283	(1993) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307	(1993a) Carbon Steel Bolts and Studs, 60000 psi Tensile Strength
ASTM A 312/A 312M	1992 (Rev. A) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 325	(1993) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 351/A 351M	(1994; Rev. A) Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 403/A 403M	1993 Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 449	(1993) Quenched and Tempered Steel Bolts and Studs
ASTM A 492	(1995) Stainless and Heat-Resisting Steel Rope Wire
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 209	(1995) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1992a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 247	(1992a) Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings
ASTM C 33	(1993) Concrete Aggregates
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 396	(1992) Fuel Oils
ASTM D 471	(1995) Rubber Property - Effect of Liquids
ASTM D 543	(1987) Resistance of Plastics to Chemicals

ASTM D 747 (1993) Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

ASTM D 751 (1995) Coated Fabrics

ASTM D 2027 (1976; R 1992) Cutback Asphalt(Medium-Curing Type)

ASTM D 2565 (1992; Rev. A) Operating Xenon Arc-Type Light Exposure Apparatus With and Without Water for Exposure of Plastics

ASTM D 3083 (1989) Flexible Poly(Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining

ASTM D 3389 (1987) Coated Fabric Abrasion Resistance (Rotary Platform, Double-Head Abrader)

ASTM D 3453 (1991) Flexible Cellular Materials -Urethane for Furniture and Automotive Cushioning, Bedding, and Similar Applications

ASTM E 94 (1992) Radiographic Testing

## AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (1993) Minimum Design Loads for Buildings and other Structures

ASTM E 96 (1995) Water Vapor Transmission of Materials

## DEPARTMENTS OF THE ARMY, THE NAVY AND THE AIR FORCE

ARMY TM 5-809-1 (1992) Structural Design Criteria Loads

ARMY TM 5-809-10 (1992) Seismic Design of Buildings

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-52557 Fuel Oil, Diesel; for Posts, Camps and Stations

## CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.23 Guarding Floor and Wall Openings and Holes

29 CFR 1910.24 Fixed Industrial Stairs

29 CFR 1910.27 Fixed Ladders

## FEDERAL SPECIFICATIONS (FS)

FS SS-S-200 (Rev. E) (Am. 1) Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, For Portland Cement Concrete Pavement

FS SS-S-1614 (Rev. A) Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements

## MILITARY SPECIFICATIONS (MIL)

MIL-A-907 (Rev. E) Antiseize Thread Compound, High Temperature

MIL-G-3056 (Rev. F; Int Am. 3) Gasoline, Automotive, Combat

MIL-T-5624 (Rev. R) Turbine Fuel, Aviation, Grades JP-4 and JP-5

MIL-R-6855 (Rev. E) (Supp. 1) Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes

MIL-V-12003 (Rev. F; Am. 1) Valves, Plug:Cast Iron or Steel, Manually Operated

MIL-P-24396 (Rev. A) Packing Material, Braided PTFE (Polytetrafluoroethylene)

MIL-T-38219 (Rev. B; Am. 1) Turbine Fuel, Low Volatility, JP-7

MIL-T-83133 (Rev. D) Turbine Fuel, Aviation, Kerosene Types, NATO F-34 (JP-8) and NATO F-35

MIL-R-83248 (Rev. C) Rubber, Fluorocarbon Elastomer, High Temperature, Fluid, and Compression Set Resistant

MILITARY STANDARDS (MIL-STD)

MIL-STD 271 (Rev F; Notice 1) Requirements for Nondestructive Testing Methods

MIL-STD-621 (Rev A; Notice 1 & 2) Subgrade, Subbase, and Test Method for Pavement Base Course Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (1988) Pipe Hangers and Supports-Materials, Design and Manufacture

MSS SP-69 (1991) Pipe Hanger and Supports-Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 11 (1994) Low-Expansion Foam

NFPA 70 (1996) National Electrical Code

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NAVFAC P-355 (1982) Seismic Design for Buildings

UNDERWRITERS LABORATORIES INC. (UL)

UL 698 (1991; R 1993, Bul. 1994) Industrial Control Equipment for Use in Hazardous (Classified) Locations

UL 886 (1994; Bul. 1994, R 1995) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

## 1.2 SUBMITTALS

Submit the following in accordance with Metric Section 01300, Submittals."

### 1.2.1 Manufacturer's Data; GA.

Manufacturer's standard catalog data, prior to the purchase or installation of the particular component, shall be highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment including storage tanks, storage tank components, and piping components. Manufacturer's data shall include:

- a. Structural steel
- b. Pipe and fittings
- c. Flange bolting
- d. Gaskets
- e. Mastic seal
- f. Gauge hatch
- g. Automatic float gauge
- h. High level alarm
- i. Thermometers
- j. Venting
- k. Grating or anti-slip floor plate for stairway
- l. Roof manholes
- m. Shell access holes
- n. Oil-resistant coating system
- o. Flexible membrane liner (FML)

### 1.2.2 Drawings; GA.

Drawings for the steel tanks shall be prepared by a registered structural engineer. Include erection diagrams and detail drawings of tank bottoms and foundations, roof, shell plates, wind girders, and openings and connections for fittings and appurtenances. Detail drawings shall be full size folded blue lines, with the title block visible. Alternative materials, dimensions, methods or departures from the Contract Drawings shall be clearly stated and be labeled as exceptions. The drawings shall include the following:

a. Tank erection details showing dimensions, sizes, thickness, gauges, materials, finishes, and erection procedures.

b. Tank component details to include as a minimum:

- (1) Sand cushion
- (2) Floating Plan, including details of support legs, manway, joint attachments, anti-rotation cable, and grounding cables
- (3) Internal pipe and fittings
- (4) Details of fire protection system components
- (5) Location of alarm and control switches
- (6) Location of gauges

c. Details of the base of any component that sets on grades; complete with attachments, anchor bolt templates, and recommended clearances for maintenance and operation.

d. Details of the electric wiring indicating applicable single line and wiring diagrams with written description of sequence of operation and the instrumentation.

e. Details showing the location, type, and description of vibration isolation devices for all applications.

f. Complete piping and wiring schematic diagrams.

### 1.2.3 Design Data; GA.

Calculations for the steel tank design shall be prepared by a registered structural engineer. Include calculations that indicate the maximum and minimum operating pressures in accordance with API STD 650, Appendix F. These calculations shall be prepared and sealed by a registered professional structural engineer.

1.2.4 Instructions; FIO. The manufacturer's installation instructions and procedures for all equipment and components including but not limited to:

- a. Mechanical tape level gauge
- b. Servo level gauge
- c. Level alarm system
- d. High liquid level control valve
- e. Flexible membrane liner (FML)

### 1.2.5 Statements; GA.

a. Welding procedures and procedure qualifications. A letter listing the qualifying procedures for each welder. The letter shall include supporting data such as test procedures used, what was tested to, etc. and a list of the names of qualified welders and their identification symbols.

b. Qualifications of nondestructive test examiners

c. Tank calibration experience

d. Verification of Dimensions. A letter stating the date the site was visited and a listing of discrepancies found.

e. Radiographic Inspections. A letter identifying each inspector and their corresponding qualifications.

f. Evidence of the installation Contractor's experience, training, and licensing.

g. A letter identifying each inspector and their corresponding qualifications.

Floating Pan; FIO.

A letter providing locations and points of contact where the floating pan design has been used in previous construction sites.

1.2.5.1 Test Examiners. Submit proof of compliance of nondestructive test examiners with API STD 650. Submit certified data on tank calibration experience.

1.2.5.2 Qualifications of Flexible Membrane Liner (FML) Field Engineer. Submit a letter providing evidence of the Contractor's and the field engineer's experience, training, and licensing. Statements of previous FML job experience shall be provided with a point of contact, a phone number, address, the type of installation, and the current status of the installation.

1.2.5.3 FML Manufacturer's Representative. Submit a letter, prior to placing the FML, from the FML manufacturer naming their authorized representative complete with their address, phone number, and a point of contact.

### 1.2.6 Test Reports; GA.

Six copies of each test containing the information described below in bound 8-1/2 by 11-inch booklets. Individual reports shall be submitted for the sand

cushion tests, the flexible liner tests, storage tank tests, floating pan tests and the piping tests. Drawings shall be folded blue lines with the title block visible.

- (1) A list of equipment used along with calibration certifications.
- (2) A copy of measurements taken.
- (3) The date of inspection.
- (4) The parameters to be verified.
- (5) The condition specified for the parameter.
- (6) The inspection results, signed, dated, and certified by the field engineer. The certification shall state that all required procedures were accomplished, that the procedures were conducted in compliance with the plans and specifications.
- (7) A description of adjustments performed.

#### 1.2.7 Records; GA.

- a. Tank calibration record
- b. Weld inspection reports

Submit reports for inspection of welds, and radiographs to the Contracting Officer's Representative.

#### 1.2.8 Special Tools; GA.

Two sets of special tools required for maintenance. Special tools are those that only the manufacturer can provide for special purposes such as reaching otherwise inaccessible parts. The tools shall be supplied complete with a suitable tool box.

#### 1.2.9 Operation and Maintenance Manuals; GA.

- a. Mechanical tape level gauge, Data Package 2
- b. Servo level gauge, Data Package 2
- c. Level alarm system, Data Package 2
- d. High liquid level control valve, Data Package 2
- e. Venting, Data Package 2
- f. Automatic float gauge, Data Package 2

Submit data package in accordance with Metric Section 01701, "Operation and Maintenance Manuals."

#### 1.2.10 Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 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, a recommended spare parts list for one year of operation, and a list of the parts recommended by the manufacturer to be replaced after [1] [and] [3] years of service. The data shall include a completed checklist for all equipment, upon completion of the installation. Each element in the checklist shall be dated and signed.

#### 1.2.11 Schedules; GA.

- a. Welding. A letter, at least 5 working days in advance of any welding tests, advising the Contracting Officer of the tests.

b. Tests; GA. A letter, at least 10 working days in advance of each test, advising the Contracting Officer's Representative of the date proposed date for each individual test.

c. Inspections; GA. A letter, at least 10 working days in advance of each inspection, advising the Contracting Officer's Representative of the date proposed date for each individual inspection.

d. Demonstrations; GA. A letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the on-site training.

#### 1.2.12 Reports; FIO.

Steel Mill reports covering chemical and physical properties of steel used in the storage tank construction.

#### 1.2.13 CALCULATIONS; FIO.

Calculations that indicate each tank's maximum and minimum operating pressures in accordance with API Std 650 Appendix F. The Calculations shall also include the buoyancy of the floating pan and the structural stability of the floating pan when resting on the support legs. These calculations shall be prepared and sealed by a registered professional structural engineer.

#### 1.3 COPIES OF API PUBLICATIONS

Provide four copies of API PUBL 2009, API STD 650, API STD 2000, and API STD 2550.

#### 1.4 RELATED REQUIREMENTS

Materials, design, fabrication, welding, erection, testing, and appurtenances shall be in accordance with API STD 650 and API STD 2000, except as otherwise specified herein. Products to be stored in the tank are JP-8 and diesel fuel.

#### 1.5 DESIGN REQUIREMENTS

Design Conditions--The tanks shall be designed to resist the following loads and forces:

a. Wind: Wind loads shall be computed and applied using a basic wind speed of 137 kilometers per hour (75 miles per hour) and an importance factor of 1.0. The wind loads and design scale shall be per ARMY TM 5-809-1 and ASCE 7.

b. Seismic Loads shall be computed for Seismic Zone 2B and in accordance with ARMY TM 5-809-10.

c. Roof Snow loads shall be developed using a ground snow load of 1.4 Kn/sq meter (20 pounds per square foot).

d. The following combinations of loads, with corresponding percentages of basic stress to be used in design, shall be allowed:

1. dead load + fuel + roof live load	100%
2. dead load + fuel + seismic	100%
3. dead load + fuel + wind	100%
4. dead load + wind (empty tank)	100%

All portions of the tank shall be designed for the governing appropriate critical load combination.

e. Determine forces from seismic loading in accordance with API STD 650.

f. The usable capacity of the tank shall be not less than 442893 liters (117,000 gallons). Nominal capacity shall be 454249 liters (120,000 gallons). The tank shall be not more than 9.8 meters (32 feet) in diameter, and shall be approximately 7.3 meters (24 feet) in height.

#### 1.5.1 Corrosion Allowance.

Make allowance of 1.6 mm (1/16") in thickness of steel for corrosion loss. Corrosion allowance shall be applied to the exterior of the shell, roof, and to surfaces of interior structural members.

#### 1.5.2 Design Metal Temperature.

API STD 650 degrees C (1200 degrees F).

### 1.6 TANK CALIBRATION EXPERIENCE

Perform calibration of the tank using a qualified organization that can certify to at least 2 years of prior successful and accurate experience in calibrating tanks of comparable type and size.

### 1.7 ELECTRICAL WORK

Switches and devices necessary for controlling the electrical equipment shall be provided. Wiring, equipment, and fittings shall be explosion-proof in conformance with the applicable requirements of UL 698 and UL 886 for Class I, Division 1, Group C and D hazardous locations. Electrical installations shall conform to the requirements of NFPA 70. Underground electrical wiring shall be enclosed in PVC coated conduit which shall be isolated from steel tanks with dielectric fittings.

### 1.8 QUALIFICATIONS

#### 1.8.1 Experience

The installation Contractor shall have successfully completed manufacturer's training courses on the installation of storage tanks, piping, and tank management systems; have at least 5 years experience in the erection of aboveground vertical steel tanks with floating pans and fixed roofs; and meet the licensing requirements in the state.

#### 1.8.2 Flexible Membrane Liner Field Engineer.

The Contractor shall meet the licensing requirements of the State in which the work is to be performed. The Contractor shall provide a field engineer full time to this project. The field engineer shall have successfully completed manufacturer's training for handling and installing FML systems as well as have at least 92,950 square meter (one million square feet) of installation experience.

#### 1.8.3 Welding

Welding shall be in accordance with qualifying procedures using performance qualified welders and welding operators. Welding tests shall be performed at the work site. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer shall not be acceptable. Each welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.

#### 1.8.4 Radiographic Inspections.

Inspectors to perform radiographic inspections on tank welds shall have qualifications in accordance with API Std 650. Inspectors to perform radiographic inspections on pipe welds shall have qualifications in accordance with MIL-STD 271 or ASTM E 94.

#### 1.9 REGULATORY REQUIREMENTS

The design, fabrication, and installation of the entire fueling system shall be in accordance with this specification as well as meet all federal, state, and local code requirements.

#### 1.10 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperatures, pressures, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of all material before, during, and after installation is the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

#### 1.12 PROJECT/SITE CONDITIONS

##### 1.12.1 Verification of Dimensions.

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

##### 1.12.2 Fuel Supply.

Fuel required for the flushing, cleaning, and testing of materials, equipment, piping, tanks, etc. as specified in this section shall be provided by the Government. Fuel will be provided by tank trucks. The Contracting Officer will furnish the equipment and services required for the tank truck operations. The Contractor shall provide the labor, equipment, appliances, and materials required for the flushing, cleaning, and testing operations. Systems shall not be flushed, cleaned, or tested with any fuel or liquid not intended for final system operation. Fuel used in the system shall remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government.

#### PART 2 PRODUCTS

System components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard as offered in catalogs for commercial or industrial use. Any non-standard product or component and the reason for its use shall be specifically identified by the Contractor in any required submittal. Each major component (tanks, pumps, control valves, filter-separators, etc.) shall have a nameplate to list the manufacturer's name, address, component type or style, model or serial number, and catalog number

on a plate secured to the equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts. One manway cover on each tank shall have a nameplate that describes special and important procedures for operating and servicing the system. The nameplate shall include warnings of hazardous procedures.

## 2.1 STORAGE TANKS

Materials used in the construction of a storage tank shall be aluminum, carbon steel, stainless steel, or a combination of each.

### 2.5.1 Aluminum.

Bars, rods, shapes and tubes shall be extruded and conform to the requirements of ASTM B 221. Plates and sheets shall conform to the requirements of ASTM B 209.

### 2.5.2 Carbon Steel.

Plates and structural members shall conform to the requirements of API Std 650, Section 2 - "Materials" with a minimum corrosion allowance of 3mm (1/16-inch). Storage tank appurtenances not covered by API Std 650 shall be in accordance with ASTM A 36, ASTM A 131, ASTM A 283, or ASTM A 285 as applicable.

### 2.5.3 Stainless Steel.

Stainless steel plates shall be Type 304 in accordance with ASTM A 240. If a center roof support column is provided it will bridge the floor drain sump at its bottom support. The column may be fabricated from carbon steel in accordance with ASTM A 53 Grade B or stainless steel, ASTM A358, Grade 304L. Stainless steel plates for miscellaneous use shall be in accordance with ASTM A 176.

## 2.2 STRUCTURAL STEEL

In accordance with API STD 650.

## 2.3 PIPE, FITTINGS, AND FLANGES

### 2.3.1 API STD 650, except as specified.

Fittings less than 50 mm shall be flanged or threaded; sizes 50 mm and larger shall be flanged or butt-welded. Flanges shall be welding neck type in accordance with ASME/ANSI B16.5. Threaded fittings shall conform to ASME B16.11, 20.7 MPa. Buttwelding fittings shall conform to ASME/ANSI B16.9. Inlet and outlet shall be stainless steel as follows:

#### 2.3.1.1 Pipe

ASTM A 312/A 312M, Schedule 40, Type 304L or 316L.

#### 2.3.1.2 Fittings

a. Buttwelding: ASTM A 403/A 403M, Class WP, Schedule 40, Type 304L or 316L.

b. Threaded: ASME B16.11, Class 3000 lb., ASTM A 182/A 182M, Type 304L or 316L, forged.

#### 2.3.1.3 Flanges.

ASME/ANSI B16.5, Class 150, ASTM A 182/A 182M, Type 304L or 316L.

#### 2.3.1.4 Flange Bolts.

ASTM A 193/A 193M, Grade B7; nuts:ASTM A 194/A 194M, Grade 7.

### 2.4 PIPE FLANGE GASKETS

ASME B16.21, spiral-wound type.

### 2.5 GASKETS FOR MANHOLES, CLEANOUTS, AND COVERS

#### 2.5.1 Flanged and Bolted Connections and Covers.

Provide composition non-asbestos gaskets.

#### 2.5.2 Roof Manhole Frames and Covers.

Provide rubber gaskets, MIL-R-6855, for covers which are not bolted.

### 2.6 MASTIC SEAL

Mastic seal for sealing foundation ring wall shall be resistant to jet fuel and shall conform to FS SS-S-200 for cold applied sealant and FS SS-S-1614 for hot applied sealant.

### 2.7 INTERIOR PROTECTIVE COATING SYSTEM

Interior tank coating shall be applied to all interior surfaces including piping and appurtenances in accordance with Section 09873 INTERIOR TANK COATING in all three bulk tanks, regardless of product stored. Tank shall have the interior coating applied following the completion of the water fill tightness test. The exterior of carbon steel piping inside the tank shall be coated equal to the tank interior coating. Areas between the underside of the tank roof and the top surface of the rafters shall be coated. Contractor will be allowed to insert small wooden blocks between the roof and the rafters, sandblast the area, and then apply the coating. After the coating has dried, remove the blocks to allow the blocked areas to be sandblasted, coated, and dried.

### 2.8 EXTERIOR PROTECTIVE COATING SYSTEM

Above ground tanks shall be painted as specified in Section 09925 EXTERIOR COATING SYSTEM FOR WELDED STEEL PETROLEUM STORAGE TANKS. Paint shall be rated for use on hot metal surfaces up to 232 degrees C (450 F) and for surfaces exposed to the weather. Color of the finish coat shall be aluminum or light gray.

## 2.9 APPURTANCES

### 2.9.1 Floating Pan

The floating pan shall be naturally buoyant by means of sealed honeycomb cells in aluminum sandwich panels, be suitable for operation with liquids having a specific gravity of 0.70, be internal to the tank, have full surface contact with the fuel, be equipped with a seal at each penetration, and meet the requirements of API Std 650 Appendix H. A rim shall be provided around the floating pan periphery and extend a minimum of 150mm above the free liquid surface. The rim shall minimize turbulence and prevent fuel from splashing up onto the top surface of the floating pan.

#### 2.9.1.1 Pan Integrity

The floating pan shall support the following loading conditions without causing damage to the pan, sinking the pan, or allowing product to spill onto the top surface of the pan in the event the pan is punctured.

- (1) A uniform load of three times the weight of the pan.
- (2) A point load of 200kg on a 0.1 square meter area anywhere on the floating pan while it is floating or resting on the legs.

#### 2.9.1.2 Joint Connections

Aluminum sandwich panels shall be joined together by means of a gasketed joint that transmits loads without structural failure or leakage.

#### 2.9.1.3 Aluminum Extrusions

Extrusions shall be made from alloy 6063-T6 in accordance with ASTM B 209.

#### 2.9.1.4 Aluminum Sandwich Panels

Panels shall be made from alloy 3003 H14, 3003 H16, 3105 H14, or 5010 H24 in accordance with ASTM B 209. The skin of the panels shall have a minimum thickness of 0.35mm. The core of the panels shall be 25mm aluminum honeycomb.

#### 2.9.1.5 Support Legs

Floating pan shall be provided with two position self draining legs that are designed to support a uniform load of 0.6 kPa. The legs shall be tubular structural members at least 50mm in diameter and ride with the pan when the fuel level is above the high position. The low position shall be 1 meter and high position shall be 2 meters. The exact location and number of the support legs shall be as recommended by the floating pan manufacturer. The legs shall be capable of allowing a person standing on top of the floating pan while the tank is in service, to perform the following functions:

- (1) Change from high to the low position
- (2) Change from the low to the high position
- (3) Completely remove the legs
- (4) Adjust the legs vertically a distance of plus or minus 3 inches.

#### 2.9.1.6 Periphery (Rim) Seals

Periphery seals shall be made of flexible polyurethane foam in accordance with ASTM D 3453 and be covered with a polyurethane coated polyester fabric wrap at least 0.5mm thick. The periphery seal shall fit the space between the tank shell and the outer edge of the floating pan with two flexible seals, a primary and a secondary. The seals, primary and secondary as a unit, shall accommodate a deviation between the path of the floating pan relative to the tank shell of an additional 100mm of compression and an additional extension of 50mm from its normal compressed position at any fluid level. The primary seal shall be above the liquid level and be free draining without trapping any liquid. The secondary seal shall be above the primary seal. Seals shall be capable of being replaced while the tank is in service, be durable in the tank's environment, be abrasion resistant, and not discolor or contaminate the liquid stored in the tank.

#### 2.9.1.7 Penetration Seals

Penetration seals shall be made of Buna-N. Vertical appurtenances such as columns, ladders, cable, etc that penetrate the floating pan shall have seals that permit a local deviation of plus or minus 125mm and have a rim that extends a minimum of 150mm above the free liquid to contain product turbulence and prevent the tank product from splashing up onto the top surface of the floating pan.

#### 2.9.1.8 Manway

A manway shall be provided for each floating pan to provide access to the tank interior when the floating pan is on its supports and the tank is empty. Manway shall have a clear inside diameter of at least 760mm. The cover shall be bolted fuel tight to the floating pan with a Buna-N gasket. Manway shall have a rim that extends a minimum of 75mm above the free liquid to contain product turbulence and prevent the tank product from splashing up onto the top surface of the floating pan.

#### 2.9.1.9 Grounding Cables

Two or more 3mm diameter grounding cables made of 304 stainless steel aircraft cable conforming to ASTM A 492, with a maximum resistance of 8.5 ohms per 100 feet shall be provided for each tank. The exact location and number of grounding cables shall be as recommended by the floating pan manufacturer.

#### 2.9.1.10 Anti-Rotation Cable

One 6mm diameter anti-rotation cable made of 304 stainless steel conforming to ASTM A 492 shall be provided for each tank. Fittings for anti-rotation cables including cable clamps, pins, sockets, turnbuckles, U-bolts, and nuts, etc shall be 304 stainless steel. Cable shall be made taut by means of the turnbuckle. The exact location of the anti-rotation cable shall be as recommended by the floating pan manufacturer.

#### 2.9.1.11 Fire Test

The floating pan shall be fire tested by both of the following tests applied to a floating test pan. The floating test pan shall be floated in JP-8. Successful conclusion of each fire test shall show that the design is adequate if no significant damage occurs to the pan, the pan continues to float, and the fire did not spread to the surface of the fuel:

(1) Hole Fire: The floating test pan shall have a 12 inch diameter hole clear through. After being lit, the fuel in the hole shall burn for a minimum of two hours.

(2) Periphery Fire: After being lit, the fuel around the test rim section shall burn for a minimum of two hours."

#### 2.9.2 Gauge Hatch

Provide gauge hatch and stilling well to within 75 mm of the bottom of the tank for manual gaging. Provide a horizontal datum plate of 6-mm thick stainless steel at the bottom of the stilling well with the top of the plate at the elevation at which the shell intersects the bottom. Equip hatch with a self-closing, foot-operated, lockdown cover of nonferrous metal. Provide gasket for dissimilar metal protection. Provide a thermometer holder. Locate hatch near roof manhole, readily accessible from the top platform of the stairway.

### 2.9.3 Automatic Float Gauge (Mechanical Tape Gauge).

Provide automatic float gauge of a type that indicates the height of the stored product in the tank by means of perforated tape actuated by a float with a dial and counter indicator with provisions for future remote transmission. The tape and cables shall be of Type 316 corrosion-resisting steel. The tape shall be held taut by a spring-loaded drum. A counterweight assembly shall not be permitted. The tape, reel, and counter mechanism shall be enclosed in a weatherproof housing with a reading window, and shall be located outside the tank near the bottom of the shell where the dial can be easily read. The dial shall be capable of adjustment at the gauge head. The gauge reading of the level of the stored product shall be accurate to within 6 mm (1/8"), plus or minus, throughout the entire operating range.

### 2.9.4 Servo Level Gauge

#### 2.9.4.1 Construction

The materials of construction of the servo level gauge, excluding "O" ring gaskets, magnetics, and electronic components, shall be constructed of either ASTM A 351/A 351M Type 316 stainless steel or cast aluminum. "O" ring gaskets shall be constructed of Buna-N. The servo level gauge shall be Underwriters Laboratory, Inc. (UL) or Factory Mutual (FM) labeled for Class I, Division 1, Group D hazardous areas, and shall have maximum temperature rating of "T2D" 215 degrees C 419 degrees F as defined by NFPA 70. The nameplate shall include the temperature rating. Unit shall be provided with a thermostatically controlled heater for prevention of condensation and freeze protection and an RTD and self compensating temperature converter. Unit shall receive 120 volts, single phase power and shall consume 60 VA, maximum.

#### 2.9.4.2 Assembly

The automatic tank level gauge assembly shall include a servo level gauge, an ASTM A 492 Type 316 stainless steel measuring wire, an unguided 146 mm (5.7 inch) diameter type 316 stainless steel displacer, an aluminum calibration chamber, local and remote level indications, and an aluminum stilling well. The measuring wire shall be of sufficient length to measure the liquid level from the bottom to the top of the storage tank.

#### 2.9.4.3 Gauge Operation

The displacer shall indicate to the servo level gauge a rise or fall in the liquid level of the tank. The servo level gauge shall be capable of sensing any movement of the displacer and provide both a local and a remote liquid level indication. The servo level gauge shall have a measuring accuracy of plus or minus 3 mm (0.01 feet).

#### 2.9.4.4 Data Transmission

When the servo level gauge senses a rise or fall in the tank liquid level, the internal processor shall be capable of providing serialized output capable of

being transmitted over a two-wire bus to remote receiver/indicator units. The units of measurement shall be millimeters (feet) and measuring increments shall be 3 mm (in) hundredths (0.01) of a foot. Wave integration time shall be 1 to 10 seconds, adjustable.

#### 2.9.5 High Level Alarm

Provide an automatic high level alarm. The system shall be capable of detecting and transmitting at least two alarm conditions, one at approximately 95 percent of tank capacity and one at approximately 98 percent of capacity. (HHLA) as indicated. Provide a level alarm control panel in the attendant building as indicated.

#### 2.9.6 Thermometers

Provide two thermometer wells designed as indicated not more than 460 mm apart. In one well, provide a 130 mm non-mercury direct-drive Bourdon tube dial thermometer with one-degree divisions and a range of minus 10 degrees C (-50 F) to plus 80 degrees C (176 F). Construct thermometer with stainless steel case, bezel, fittings, and stem. Seal head against dust, fumes, and moisture. Provide a threaded plug for the second well

#### 2.9.7 Venting

Provide open vent at the center or at the highest elevation of the roof. Open vent shall have a weatherhood, with galvanized steel bird screen with 6 mm (1/4") opening and a 3.5 mm (10gauge) minimum wire diameter. Provide flame snuffer operable by pull chain on external open vents.

#### 2.9.8 Circumferential Stairway and Platform

OSHA 29 CFR 1910.24 and 29 CFR 1910.23. Support the stairway completely on the shell of the tank with ends of the stringers clear of the ground, and at an angle of approximately 0.785 rad. Construct stairway entirely of steel with treads of grating or an approved antislip floor plate. Railing shall be continuous around the platform except for access openings. At access openings, any space wider than 75 mm (3") between the tank and the platform shall be floored.

#### 2.9.9 Ladders

29 CFR 1910.27. Provide vertical interior ladders extending from the roof manholes to the tank bottom. Provide exterior ladders or catwalks as required to gain access to the second roof manhole, which is on the opposite side of the tank from the stairway platform. Provide drainage for horizontal surfaces such as stairs and floored surfaces made from steel plates. Ladder shall have a safety rail system with three safety belts and trolleys. The rail shall have a removable extension with clamps.

#### 2.9.10 Roof Manhole

Provide 600 mm minimum square manhole for access to the interior of the tank through the roof. Manway shall be gasketed fuel tight, with a Buna-N gasket and include a gauge hatch. Provide manway with safety handrails located directly over the interior ladders. Provide hinged and weathertight manhole covers with a formed fit. The gauge hatch shall be made of aluminum conforming to ASTM B 247 or bronze conforming to ASTM B 62, have a cover that is foot-operated to open, self-closing, lockable, and gasketed fuel tight with a Buna-N gasket.

#### 2.9.11 Shell Access Holes

Provide two 750 mm diameter access holes. Locate the access holes in the tank shell on opposite sides of the tank on a diameter approximately 1.57 rad from the roof manholes and at a height convenient for personnel access into the tank. Provide access holes with welded steel plate frames and covers. Secure the cover plates with corrosion-resistant bolts and nuts. Provide access holes with gaskets and smooth gasket seats. Manhole shall be gasketed fuel tight with a Buna-N or NBR gasket.

#### 2.9.12 Fittings and Piping

Provide fittings and piping and other miscellaneous items as necessary to permit tank operations.

##### 2.9.12.1 Product Inlet

Product inlet connections shall consist of an external flange, a nozzle through the tank shell, supports, and an internal expanding cone, as indicated. The flange shall be 1034 kPa, conforming to ASME/ANSI B16.5 with slip-on or welded neck.

##### 2.9.12.2 Product Outlet Connection

Product outlet connection shall consist of an external flange, a nozzle through the tank shell, internal flanges, elbows, product withdrawal line assembly, and supports, as indicated.

##### 2.9.12.3 Water Drawoff System

A water draw-off system shall be provided for each bulk storage tank. Each system shall include tank and all necessary pipe, valves and fittings. Components of the water draw-off system shall be installed and secured in place by anchor bolts.

Water drawoff connection shall consist of an external flange or coupling, nozzle and 50 mm pipe through the tank shell, supports, and fittings to a point 50 mm above the bottom of the center sump, as indicated. Provide an electric operated drain pump with a maximum discharge as indicated on the water drawoff line.

###### 2.9.12.3.1 Tank

The water draw-off tank and support legs shall be fabricated from ASTM A 176 Type 304 stainless steel. Over-all capacity shall be as indicated.

###### 2.9.12.3.2 Sight Glass

Sight glasses for the water draw-off tank shall be standard tubular gauges with density ball and shutoff valves on each end. Wetted parts other than sight glass shall be stainless steel. If glass breakage should occur, a stainless steel ball in the valve shall close preventing product loss. Glass shall be protected by minimum of four guard rods.

#### 2.9.13 Scaffold Cable Support

Provide scaffold cable support on the tank roof in accordance with API STD 650. Locate the support near the center of the tank and in a manner that supported cables will have maximum range and flexibility of operation with minimum interference with other tank fittings.

#### 2.9.14 Plug (Double Block and Bleed) Valves.

Valves shall be provided as indicated and as specified in Section 13202 FUEL STORAGE SYSTEMS.

#### 2.9.15 Level Alarm System.

System shall be designed and installed in such a way that the system shall be continuously and automatically self-checking without manual check. Electronic level sensors shall be thermistors or optic types, and be intrinsically safe Class I, Division 1, Group D for hazardous environments, with recognized FM, CSA or UL approval. Both high electronic level sensors shall be contained in a single multi-sensor holder/junction box. The sensor holder/junction box shall be accessible from the tank top or stairway.

##### 2.9.15.1 Electronic Level Alarms.

Level alarms shall be mechanically and electrically independent and be totally isolated from the gauging system. Two electronic high level alarms shall be provided for each tank. A High Level Alarm (HLA) shall be set at approximately 95 percent of the safe tank filling height and be arranged to actuate an audible alarm signal located at or near the normal station of

the person in control of the tank filling operation. A High High Level Alarm (HHLA) shall be set at approximately 98 percent of the safe filling height. HHLA shall sound an audible and visual alarm at a control panel and close the High Liquid Level Control Valve. In addition, an electronic

low level alarm shall actuate a visual and audible signal at the control panel when the tank is less than 5 percent filled.

##### 2.9.15.2 Level Alarm Control Panel.

Panel shall be located where indicated and contain one light and one relay output for each alarm point. An audible alarm shall actuate whenever any alarm point has been reached. Panel shall further contain a green (Power ON) status light and push button controls for alarm reset and test. Panel shall consist of a NEMA 4 style water-tight housing for outdoor mounting locations. Panel shall operate with 115 VAC input power. Circuitry and cables from the panel to the electronic level sensors in the tank shall be intrinsically safe.

#### 2.9.16 High Liquid Level Control Valve

##### 2.9.16.1 Valve

Valve shall be hydraulically operated, single-seated, normally closed, diaphragm actuated, on/off type valve. Valve shall be field adjustable. Valve shall be provided with a position indicator, float operator and assembly, pressure-operated pilot valves and accessories, solenoid-operated pilot valve, and pressure gauge quick-disconnect fittings located in the valve inlet, outlet, and cover. Valve shall also operate with a special check valve feature and close rapidly when outlet pressure exceeds inlet pressure. Service and adjustments shall be possible without removing the valve from the line. Portions of the valve coming in contact with fuel shall be compatible with the fuel and be of corrosion-resistant material. Valve shall have bodies, bonnets, and covers constructed of cast steel conforming to ASTM A 216/A 216M, Grade WCB internally plated with chromium, nickel, or electroless nickel. Stem and trim shall be stainless steel. Valve shall be suitable for a working pressure of 1900 kPa at 38 degrees C (275 psig at 100 degrees F) with a weatherproof housing. Valve packing shall be Viton in accordance with MIL-R-83248 or PTFE in accordance with MIL-P-24396. Valve shall be provided with flanged end connections which are constructed of the same material as the valve body.

##### 2.9.16.2 Float Operator and Assembly.

Float operator and assembly shall be Grade CF3 (Type 304L) or Grade CF8M (Type 316) stainless steel conforming to ASTM A 351/A 351M. Float operator shall be field adjustable. Float operator shall control the high liquid level control valve based on the indicated actuation point. The float operator and assembly shall be mounted to the storage tank's exterior where indicated. Means shall be provided to test the float operator's operation and the control system's response.

#### 2.9.16.3 Pressure-Operated Pilot Valves and Accessories.

Valves shall be the adjustable, pressure-operated type and be adjustable in the field. Valves shall be tag identified and be stainless steel conforming to ASTM A 351/A 351M, Grade CF3 (Type 304L) or Grade CF8M (Type 316) with stainless steel internal working parts. A 40 mesh stainless steel screen, self-cleaning strainer shall be provided in the pilot valve supply piping. Pilot system tubing shall be Type 316 stainless steel in accordance with ASTM A 269. Control, supply, and return connections shall be provided with isolation valves. Tubing connections shall be made with unions and not be welded or sealed with "O" rings.

#### 2.9.16.4 Solenoid-Operated Pilot Valve.

Valve shall be used for the electronic level alarm sensor control of the high liquid level control valve. Valve shall be tag identified and be stainless steel conforming to ASTM A 351/A 351M, Grade CF3 (Type 304L) or Grade CF8M (Type 316) with stainless steel internal working parts. Valve shall have a manual type operator or needle valve for emergency manual bypass operation. Activation of this emergency manual bypass override, during filling operations when no electrical power is available, shall cause a visible and audible indication of override status at the Level Alarm Control Panel when electrical power is restored to the system. Solenoids shall operate on 120 volts, 60 Hz, single phase power and be housed in an UL labeled explosion-proof case for Class I, Division 1, Group D areas with maximum temperature rating of "T2D" 215 degrees C (419 degrees F).

#### 2.9.16.5 Control Valve Operation.

The high liquid level control valve shall fully close when either the float operator or the HHLA electronic level alarm sensor are activated. Valve shall fully open when the tank's fuel is below the float operator's actuation point and the HHLA electronic level alarm sensor is not activated. Means shall be provided to test the control system's response at the activation point.

#### 2.9.17 Fixed Roof.

The roof-to-shell joint shall be frangible type as defined in API Std 650 Appendix F, NAPA 30, and API Std 2000 to satisfy emergency venting requirements. Tank roof shall have a bolted rectangular opening suitable for installation of floating pan panels.

#### 2.9.18 Pump Interlock.

Provide an automatic high and low level contact for pump shutdown of pumps CP-1, CP-2, CP-3, or CP-4. The system shall be capable of detecting fuel at approximately 95 percent tank capacity (HLA), and shall subsequently disengage a pump permissive contact to de-energize the pump. The system shall also be capable of detecting when the fuel level falls below approximately 5 percent tank capacity (LLA) as indicated, and shall subsequently disengage a pump permissive contact to de-energize the pump.

#### 2.9.19 Inspection Hatch

A minimum of one hatch is required per tank.

## ~~2.9.20 High Liquid Level Control Valve~~

### ~~2.9.20.2 Valve.~~

~~Valve shall be hydraulically operated, single seated, normally closed, diaphragm actuated, on/off type valve. Valve shall be field adjustable. Valve shall be provided with a position indicator, float operator and assembly, pressure operated pilot valves and accessories, solenoid operated pilot valve, and pressure gauge quick disconnect fittings located in the valve inlet, outlet, and cover. Valve shall also operate with a special check valve feature and close rapidly when outlet pressure exceeds inlet pressure. Service and adjustments shall be possible without removing the valve from the line. Portions of the valve coming in contact with fuel shall be compatible with the fuel and be of noncorrosive material. Valve shall have bodies, bonnets, and covers constructed cast steel conforming to ASTM A 216, Grade WCB internally plated with chromium, nickel, or electroless nickel. Stem and trim shall be stainless steel. Valve shall be suitable for a working pressure of 275 psig at 100 degrees F with a weatherproof housing. Valve packing shall be Viton in accordance with MS MIL R 83248, Buna N, or PTFE in accordance with MS MIL P 24396. Valve shall be provided with flanged end connections which are constructed of the same material as the valve body.~~

### ~~2.9.20.3 Float Operator and Assembly~~

~~Float operator and assembly shall be Type 304L or Type 316 stainless steel conforming to ASTM A 351. Float operator shall be field adjustable. Float operator shall control the high liquid level control valve based on the indicated actuation point. Valve shall be actuated automatically upon fuel rising to the 95 percent fill level; the main valve shall remain closed until product falls below the 90% fill level. The float operator and assembly shall be mounted to the storage tank's exterior where indicated. Means shall be provided to test the float operator's operation and the control system's response.~~

### ~~2.9.20.4 Pressure Operated Pilot Valves and Accessories.~~

~~Valves shall be the adjustable, pressure operated type and be adjustable in the field. Valves shall be tag identified and be stainless steel conforming to ASTM A 351, Type 304L or Type 316 with stainless steel internal working parts. A 40 mesh stainless steel screen, self-cleaning strainer shall be provided in the pilot valve supply piping. Pilot system tubing shall be Type 316 stainless steel in accordance with ASTM A 269. Control, supply, and return connections shall be provided with isolation valves. Tubing connections shall be made with unions and not be welded or sealed with "O" rings.~~

### ~~2.9.20.5 Solenoid Operated Pilot Valve~~

~~Valve shall be used for the electronic level alarm sensor control of the high liquid level control valve. Valve shall be tag identified and be stainless steel conforming to ASTM A 351, Type 304L or Type 316 with stainless steel internal working parts. Valve shall have a manual type operator or needle valve for emergency manual bypass operation. Activation of this emergency manual bypass override, during filling operations when no electrical power is available, shall cause a visible and audible indication of override status at the Level Alarm Control Panel when electrical power is restored to the system. Solenoids shall operate on 120 volts, 60 cycle, single phase power and be housed in an UL labeled explosion proof case for Class I, Division 1, Group D areas with maximum temperature rating of "T2D" 419 degrees F.~~

#### ~~2.9.20.5 Control Valve Operation~~

~~The high liquid level control valve shall fully close when either the tank's fuel level is above the float operator's actuation point or the HHLA electronic level alarm sensor is activated. Valve shall fully open when the tank's fuel level is the below the float operator's actuation point and the HHLA electronic level alarm sensor is not activated. Means shall be provided to test the control system's response at the activation point.~~

### 2.9.21 Pipe Supports

#### 2.9.21.1 Exterior to Tanks.

The assembly shall include a Type 35 pipe slide and slide plate support mounted to Type 52 variable spring base support. The Type 52 support shall be mounted to a concrete support. Both supports shall be in accordance with MSS SP-58 and MSS SP-69. The pipe slide of the Type 35 support shall be carbon steel. The slide plate of the Type 35 support shall be PTFE in accordance with MS MIL-P-24396 or graphite coated carbon steel. The slide plate of the Type 35 support shall include side retainer walls and hold-down lugs.

2.9.21.2 Interior to Tanks. The assembly shall be constructed of steel angle frames with slotted bolt holes. The frames shall be in accordance with ASTM A 36. The assembly shall be held together with ASTM A 193 stainless steel nuts and bolts. Each leg of the assembly shall be welded to a 6-inch circular sheet of steel, which in turn shall be welded to the tank bottom. The entire assembly shall be coated with the same material as specified for the interior of the tank.

#### 2.9.22 Flexible Ball Joints.

Flexible ball joints shall be provided in the piping at the connections to the tank that will allow for the greater of 9-inches of tank settlement or the maximum allowable settlement of the tank. Stainless steel ball joints shall conform to ASTM A 351 and have polished stainless steel balls. Carbon steel ball joints shall conform to ASTM A 216 and have chromium plated carbon steel balls. Ball joints shall have pressure-molded mineral filled composition type internal seals, be suitable for continuous operation at 13 kPa (275 psig) at 38 degrees C (100 degrees F), be capable of 360 degree rotation, and be capable of accepting a 7 1/2 degree angular difference between the centerline of the pipe incoming to the joint on opposite sides.

#### 2.9.23 Flanges.

Flanges installed on equipment, fittings, or pipe shall be Class 150 pound flanges which are rated in accordance with ASME B16.5. Flange bolts and nuts shall be hexagonal and conform to ASTM A 307, Grade B. Pipe flange faces shall mate with equipment flange faces. Flanges shall be of the same material as the equipment, fitting, or pipe. Flanges shall be raised-face type.

#### 2.9.24 Pipe Flange Gaskets

Gaskets shall be 6mm (1/8-inch) thick, full face or self-centering flat ring type NBR and be in accordance with ASME B16.21.

#### 2.9.25 Electrically Isolating Gaskets for Flanges.

Flanges shall be provided with an electrical insulating material of 1,000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of the type of fuel to be handled. Gaskets shall be full face. Flanges shall have a 1mm (0.03-inch) thick, mylar insulating sleeve between the bolts and the holes. Bolts may have reduced shanks of diameter not less than the diameter at the root of the threads. Flanges shall be provided with 6mm (1/8-inch) thick high-strength phenolic insulating washers.

### 2.9.26 Strainer

Strainer shall be in accordance with MS MIL-S-13789, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, and be the same size as the pipeline. Strainer body shall be fabricated of cast steel with the bottom drilled and tapped with a ball valve. The body shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with a removable cover and sediment screen. Screen shall be 60 mesh wire screen with larger wire mesh reinforcement. Screen shall be Type 316 stainless steel. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

### 2.9.27 Miscellaneous Components

Valves and other piping components are specified in Section 13202 FUEL STORAGE SYSTEMS.

### 2.10 FUEL RESISTANT PLASTIC MEMBRANE (FML)

Provide fuel resistant plastic membrane with a minimum thickness of 0.50 mm (20 mils) under the tank. The FML shall demonstrate the acceptable limits of the properties listed under Table 1. The FML shall be factory produced from a base fabric that is completely covered with a polymer. The base fabric shall weigh no less than 440 grams per square meter (13 ounces per square yard) and be made of aramid (kevlar), polyester, or nylon. The FML shall have an overall finished weight no less than 1017 grams per square meter (30 ounces per square yard). Factory seams shall be made with a 50 mm (2 inch) overlap plus or minus 6 mm (1/4 inch) by an automatic thermal high-pressure welding process. The FML shall retard the growth of mildew and be capable of containing the liquid stored, withstanding temperatures up to 82 degrees C (180 degrees F), withstanding humidity up to 99 percent relative humidity, and withstanding direct exposure to sunlight.

#### 2.10.1 Job Lot of FML

A job lot of FML is defined by this specification as the amount of FML product that can be produced from a singular mixture of chemicals. Any FML material created from a new or altered mixture of chemicals shall be considered a new job lot.

#### 2.10.2 FML Samples

Twenty four samples shall be cut from every job lot of FML. Each sample shall be approximately 216 by 280 mm (8 1/2 by 11 inches) in size. Eight of the samples shall be cut across factory seams.

#### 2.10.3 FML Factory Test

Each manufacturer's job lot of FML shall have each of the FML properties verified by the factory test procedures and methods listed below. No substitute methods shall be allowed for verification of any property. Each separate verification of a property shall be made on a separate sample. The FML shall demonstrate through factory testing the acceptable limits of the following properties listed in Table 1. The properties shall be verified by each of the test standards listed.

TABLE 1.

## Standards and Limits for FML Properties (Metric)

	<u>Acceptable Property Limits</u>	<u>Test Standard</u>	Notes
Minimum Overall Finished Thickness	0.81 mm	ASTM D 751	
Minimum Tear Strength (ibd)	178 N Tongue Method (Warp & Fill)	ASTM D 751	
Minimum Adhesion Strength per 25 mm	89 N	ASTM D 751	
Minimum FML (MTS) (ibd)	4448 N Grab Method (Warp & Fill)	ASTM D 751	
Minimum FML (MTS)(ibd)	2670 N Cut Strip Method (Warp & Fill)	ASTM D 751	
Minimum FML Seam Shear Strength		ASTM D 751	See Note 1
Minimum Abrasion Resistance	5000 cycles	ASTM D 3389	See Note 2
Minimum Withstanding of Accelerated Weathering	1000 hours	ASTM D 2565	See Note 3
Minimum Bursting Strength	10 343 kPa	ASTM D 751 Ball Tip Method	
Maximum Stiffness(ibd)	206 850 kPa	ASTM D 747	
Hydrostatic Resistance	3448 kPa	ASTM D 751	
Maximum Permeability	30.5 grams per square meter per 24 hours	ASTM E 96 Procedure BW	See Note 4
Fuel No Delamination, Compatibility	No Bubbles, No Discoloration		See Note 5
Maximum Volume Swell (Coating Compound Only)	15 percent of original		See Note 6
Maximum Weight Gain or Loss	10 percent of original		See Note 5

TABLE 1.

## Standards and Limits for FML Properties (English)

	<u>Acceptable Property Limits</u>	<u>Test Standard</u>	<u>Notes</u>
Minimum Overall Finished Thickness	32 mils	ASTM D 751	
Minimum Tear Strength (ibd)	40 pounds Tongue Method (Warp & Fill)	ASTM D 751	
Minimum Adhesion Strength per inch	20 pounds	ASTM D 751	
Minimum FML (MTS) (ibd)	1000 pounds Grab Method(Warp & Fill)	ASTM D 751	
Minimum FML (MTS)(ibd)	600 pounds Cut Strip Method (Warp & Fill)	ASTM D 751	
Minimum FML Seam Shear Strength		ASTM D 751	See Note 1
Minimum Abrasion Resistance	5,000 cycles	ASTM D 3389	See Note 2
Minimum Withstanding of Accelerated Weathering	1,000 hours	ASTM D 2565	See Note 3
Minimum Bursting Strength	1,500 pounds	ASTM D 751 Ball Tip Method	
Maximum Stiffness(ibd)	30,000 pounds	ASTM D 747	
Hydrostatic Resistance	500 pounds per square inch	ASTM D 751	
Maximum Permeability	0.10 ounces per square foot per 24 hours	ASTM E 96 Procedure BW	See Note 4
Fuel No Delamination, Bubbles,	No Compatibility No Discoloration		See Note 5
Maximum Volume Swell (Coating Compound Only)	15 percent of original		See Note 6
Maximum Weight Gain or Loss	10 percent of original		See Note 5

## Table Abbreviations:

(ibd) in both direction

(MTS) Material Tensile Strength

## Notes:

1. The acceptable limit for the seam shear strength shall be 95 percent of the minimum (MTS) property using the Strip Method.

2. Test until fabric exposure with a H-22 wheel loaded to 1,000 grams.
3. Manufacturer's certification of the FML, instead of actual factory testing, may be considered acceptable for the Minimum Withstanding of Accelerated Weathering if the certification verifies that the acceptable limits listed were previously achieved using the test standard listed. Data from either a manufacturer's certification or an actual factory test shall verify that no visible cracking or appreciable changes resulted as a result of the testing.
4. The test shall be performed using the Inverted Water Method with ASTM Fuel B.
5. Testing shall be performed in accordance with ASTM D 543 by immersion in ASTM Fuel B for 14 continuous days at room temperature.
6. Testing shall be performed in accordance with ASTM D 471.

#### 2.10.4 FML Ring Wall Sealant.

The FML ring wall sealant shall be compatible with the FML, concrete, and the fuel being stored.

#### 2.10.5 FML Components.

Components such as sleeves, boots, etc., shall be factory prefabricated from the FML material and have the same fabrication characteristics.

2.10.6 Fuels for Testing FML. Materials, other than the FML, shall be resistant to the fuel or fuels being stored. Fuels as required or mentioned by this specification shall be in accordance with the following:

2.10.6.1 Not Used

2.10.6.2 Diesel.

Diesel shall be in accordance with CID A-A-52557.

2.10.6.3 Not Used

2.10.6.4 Not Used

2.10.6.5 JP-8.

Fuel shall be in accordance with MIL-T-83133.

2.10.6.7 Not Used

#### 2.11 ANTISEIZE COMPOUND

Provide antiseize compound for fasteners on tank exterior flanges and bolted connections and covers. Provide MIL-A-907 compound on steel fasteners. Provide an approved antiseize compound for stainless steel fasteners. Do not use MIL-A-907 compound on stainless steel. On tank interior fasteners, use oil only.

#### 2.12 SAND CUSHION

Cushion shall be located on top of the flexible membrane liner (FML) and beneath the tank bottom plates. Cushion shall be a minimum of 8 inches thick and be fine sand aggregate in accordance with ASTM C 33. Cushion shall contain no more than 25 parts per million (ppm) chlorides, no more than 30 ppm sulfates, and have a pH greater than 7. Magnesium sulfate shall be used in

the ASTM C 88 soundness test. Oil to be mixed with the sand cushion shall be grade 4, or 6 fuel oil conforming to ASTM D 396 or MC 250 asphalt conforming to ASTM D 2027. Fuel oils shall not contain sulfur or other corrosive materials in concentrations in excess of 0.05% by weight.

### 2.13 FUELS

Galvanized materials (zinc coated) shall not be allowed direct contact with any type fuel. Materials which come in contact with aviation fuel shall be noncorrosive (i.e. stainless steel, aluminum, etc.). Fuels supplied by the Government will be in accordance with the following:

#### 2.13.1 Motor Gasoline (Mogas).

Mogas will be in accordance with MS MIL-G-3056.

#### 2.13.2 Diesel.

Diesel will be in accordance with FS VV-F-800.

#### 2.13.3 JP-8 (Aviation Fuel)

Fuel will be in accordance with MS MIL-T-83133.

### 2.14 Gaskets

Gaskets shall be factory cut from one piece of material.

#### 2.14.1 Nitrile Butadiene (Buna-N)

Buna-N material shall be in accordance with SAE AMS 3275.

#### 2.14.2 Acrylonitrile Butadiene Rubber (NBR).

NBR material shall be made of material conforming to SAE AMS 3275.

#### 2.14.3 Structural Steel Shapes.

Fabricated structural steel shapes shall be in accordance with ASTM A 36.

#### 2.14.4 Bolts.

Bolts used for structural steel connections shall be in accordance with ASTM A 307 and ASTM A 325.

#### 2.14.5 Anchor Bolts

Anchor bolts shall be in accordance with ASTM A 307 and ASTM A 449.

#### 2.14.6 Bird Screens

Vents, ports and similar openings shall be screened with 15mm (1/2 inch) expanded metal bird screen.

#### 2.14.7 PVC Mounting Strip

The PVC mounting strip used to mount the FML shall be in accordance with ASTM D 3083.

### 2.15 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.15.1 Earthwork

Excavation and backfill shall be as specified in Section 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein. Backfill for steel tanks and pipe, aluminum pipe, and stainless steel pipe shall be pea gravel, crushed stone, or sand. Backfill for non-metallic pipe shall be in accordance with manufacturer recommendations. See also Section 13202, FUEL STORAGE SYSTEMS paragraph SUPPLEMENTAL COMPONENTS/SERVICES.

### 2.15.2 Concrete

Concrete, including the ring wall, shall be supplied and installed in accordance with Section 03300 CONCRETE FOR BUILDING CONSTRUCTION

### 2.15.3 Identification Markings

Above grade tanks, pipe, equipment, etc. supplied under this section shall have identification markings applied in accordance with Section 09900 PAINTING, GENERAL. Flow direction and pipe contents shall be clearly indicated within the tank farm, at the pump/filter equipment area, and at the fueling islands.

### 2.15.4 Cathodic Protection

Cathodic protection of a storage tank's bottom shall be in accordance with Section 16642: CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT).

## PART 3 EXECUTION

The installation Contractor shall supervise the complete installation of the fueling system and perform all inspections and tests.

### 3.1 SAFETY PRECAUTIONS

API PUBL 2009 for fire and explosion hazard areas.

### 3.2 CONSTRUCTION

#### 3.2.1 Tank

Provide tank of welded construction, and support tank on a concrete ring wall. Slope the tank bottom down to the center sump approximately 150 mm for each 3 m of tank radius. Butt-weld or lap-weld bottom plates with the outer plates on top. Slope the roof down from the center to the periphery. Reinforce openings larger than 50 mm (2 inches) in diameter through plating of the tank shell and roof. Provide structural stiffening, consisting of rings, thicker plates, or other approved means to maintain roundness when the tank is subjected to wind or seismic loads. Openings larger than 2-inches through the shell of the tank shall be reinforced. Shop and field fabrication shall meet the requirement of API Std 650 as adjusted herein. Spacing distances between weld seams and all shell penetrations (including manways) shall be in accordance with API Std 650. Work shall be fabricated and erected in accordance with the fabricator's approved erection drawings. Vertical appurtenances shall be plumb within a tolerance of 3-inches at one end over its length.

##### 3.2.1.1 Prohibition of Protective Coatings on Surfaces to be Welded.

Remove protective coatings on surfaces to be welded and on surfaces not less than 25 mm from weld preparation. "Weld-through" inorganic zinc coatings and similar coatings will not be permitted.

3.2.1.2 Welding of Column Base. When columns are provided in the tank, weld the column base to the tank bottom. Welds shall be continuous and shall provide a seal against the entry of water or other liquids into the space between the column base and the tank bottom.

3.2.1.3 3.2.1.3 Outer Shell. The outer shell plates shall be approximately of equal length and preformed to the curvature of the tank, a compensating allowance in preforming being made at the welding edges of 1/4-inch thick plates to produce a finished shell without distortion from a true cylindrical surface at the welded joint. The maximum distortion tolerances shall not exceed the requirements in API Std 650. Plates shall be aligned, shaped and clamped in place prior to welding by press, roll or drawbar methods. Plates shaped by hammering shall not be accepted. Shell joints shall be butted and welded on each side to have complete penetration and fusion. Interior welds on the inside of the shell plates shall be smoothed by grinding or other suitable mechanical process to the extent that no sharp or abrupt irregularities remain and the welds present a smooth crown surface. Special care shall be taken to prevent excessive build up in all welded horizontal and vertical seams.

3.2.1.4 Bottom. Bottom plate joints shall be lap welded with butt-welded annular bottom plates in accordance with API Std 650. Bottom plates shall be installed with the lower plates under the upper plates to permit drainage to center sump. Interior welds on the tank bottom plates shall be smoothed by grinding or other suitable mechanical process to the extent that no sharp or abrupt irregularities remain. Welds shall present a smooth crown surface for painting.

#### 3.2.1.5 Defect Removal

The determination of limits of defective welding and repair of defective welds shall be in accordance with API Std 650. Grind off rough surfaces on weld seams, sharp edges and corners to a radius of not less than 6mm (1/8-inch).

#### 3.2.1.6 Welding Procedures

Welding shall be done using qualified welding procedures. The surface shall be cleaned before welding. Repair welds shall be made using an electrode or filler wire preferably smaller than that used in making the original weld. Repair welds shall meet the original weld's requirements.

#### 3.2.1.7 Floor and Roof Welded Appurtenance Connections.

Appurtenance connections to be welded to the floor or roof of a storage tank shall be made prior to application of the interior coating.

### 3.2.2 Area Beneath Tank & Misc.

#### 3.2.2.1 Sand Cushion

Cushion shall be spread, leveled, thoroughly compacted, and graded to provide a 5 percent sloped bottom to the center sump. Cushion shall be dampened with oil to aid in compaction. The oil-sand mix shall be prepared by thoroughly mixing either in a concrete mixer or "windrowing" with a grader, or by hand. Only sufficient oil shall be used to thoroughly wet the sand. The oiled sand

shall be spread, leveled and thoroughly compacted and graded. The oiled sand layer shall be compacted to 100 percent of maximum density per MIL-STD 621, Test Method 100, compaction effort designation CE55. Any damage to the finished sand cushion shall be repaired prior to the erection of the tank.

Oil shall be clean. Used oil shall not be used. Oil shall have pH, chloride content, and sulphate concentration in accordance with API RP 651.

#### 3.2.2.2 FML

Flexible membrane liner shall be installed in accordance with paragraph INSTALLATION OF FML. Lay the plastic over a thoroughly compacted select subgrade free from rocks that could puncture the plastic. Provide a minimum 100 mm of compacted clean sand or similar material over the plastic. Securely attach and cement the plastic membrane to the inside of the concrete foundation ring wall beneath the tank shell. Provide a drain pipe or pipes through the concrete foundation ring wall so that water beneath the tank can escape by gravity. The drain pipe shall also serve as a telltale for tank bottom leaks.

#### 3.2.2.3 Piping

Piping shall be free of traps and drain toward the storage tanks. No pipe of any type shall be embedded in concrete pavement. Any pipe, fittings, or appurtenances found defective after installation shall be replaced. Pipe and accessories shall be handled carefully to assure a sound, undamaged condition. The interior of the pipe shall be thoroughly cleaned of all foreign matter and be kept clean during installation. The pipe shall not be laid in water or stored outside unprotected when weather conditions are unsuitable. When work is not in progress, open ends of pipe and fittings shall be securely closed so that water, earth, or other substances cannot enter the pipe or fittings. Cutting pipe, when necessary, shall be done without damage to the pipe. Pipe shall be reamed to true internal diameter after cutting to remove burrs. Pipe sections shall be installed as indicated and be complete prior to performing any piping tests.

#### 3.2.2.4 Framed Instructions

Framed instructions shall include equipment layout, wiring and control diagrams, piping, valves, control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The framed instructions shall be framed under glass or laminated plastic and be posted where directed by the Contracting Officer. The framed instructions shall be posted before acceptance testing of the system.

#### 3.2.3 Mastic Seal

Seal the outer edge of the joint between the concrete tank foundation ring and the tank floor plate by caulking with mastic seal.

#### 3.2.4 Nozzles

Nozzles less than 50 mm (2 inches) in size shall be flanged or screwed type. Sizes 50 mm (2 inches) in size or larger shall be flanged and shall have reinforcing plate. Nozzles for pipe connections inside the tank shall be flanged inside and outside of tank. Reinforcing plates for shell nozzles shall be rolled to the curvature of the shell.

#### 3.2.5 Drain Sump

Weld drain sump to the lowest point of the tank bottom. Construct drain sump of extra strong steel buttwelding pipe cap installed below the tank bottom, and provide with a stripping line as indicated.

### 3.2.6 Not Used

### 3.2.7 Cathodic Protection.

Provide cathodic protection in accordance with Section 16642 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)

## 3.3 INSTALLATION OF FML

### 3.3.1 Field Engineer.

The field engineer shall supervise the complete installation of the FML and perform each FML inspection and test.

### 3.3.2 Preparation.

Prior to laying out the FML, three sample field seams shall be performed. Each seam shall be 1500 mm (5 feet) in length. Seams shall be made only when the ambient temperature and the temperature of the FML are both minus 4 degrees C (25 degrees F) or higher.

### 3.3.3 Surface Preparation.

The surfaces to be covered shall be free of vegetation, rocks, debris, etc., graded true, compacted, and be smooth with no abrupt projections of any kind.

### 3.3.4 FML Layout and Installation.

After successful completion of the FML visual inspection, the FML shall be laid out. Laying out and welding FML shall only be done when the ambient temperature and the temperature of the FML are both minus 4 degrees C (25 degrees F) or higher. Field seams shall have a 50 mm (2 inch) overlap plus or minus 6 mm (1/4 inch), and be made by the FML manufacturer's authorized representative. Panels or sheets of FML to be seam welded together shall be laid out prior to welding field seams. The overlapped areas shall be cleaned and prepared according to the installation instructions and procedures. Welds shall be tightly bonded.

## 3.4 FIELD QUALITY CONTROL

The Contracting Officer's Representative will conduct field inspections and witness field tests and trial operations specified in this section. The Contractor shall perform all trial operations and field tests and provide all labor, equipment and incidentals required for testing. The Government will provide water required for field tests, when available.

### 3.4.1 FML Tests

### 3.4.2 FML Vacuum Box Test.

After successful completion of the FML visual inspection, a vacuum box test shall be performed on all field seams, the area around the seams, and all FML surfaces showing injury due to scuffing, penetration by foreign objects, or distress from rough subgrade. A glass topped vacuum box which has a

neoprene sealing gasket shall be used. The vacuum box test shall be performed as follows:

a. A commercial bubble forming solution shall be applied to the area to be tested.

b. The vacuum box shall be positioned over the area and a vacuum slowly applied until a differential pressure of 7 kPa (one psi) is achieved and held for at least 5 seconds while observing the solution for bubble formation.

c. If the vacuum box test indicates a continuous stream of bubbles on repeated testing at the same location, then the area being tested shall be considered damaged and shall be repaired and retested.

d. If the vacuum box test do not indicate a leak, then the vacuum shall be slowly increased until a maximum differential pressure of 14 kPa plus 0.0 or minus 2 kPa (2 plus 0.0 or minus 0.25 psi) is achieved and held for at least 20 seconds. If the test indicates a continuous stream of bubbles on repeated testing at the same location, then the area being tested shall be considered damaged and shall be repaired and retested. Care must be taken to limit the vacuum to no more than the maximum differential pressure; if it is exceeded by more than 2 kPa (0.25 psi) the FML shall be considered damaged and shall be replaced and retested.

#### 3.4.2.1 FML Air Lance Tests.

After successful completion of the FML vacuum box test, an air lance test shall be performed on all seams not accessible with a vacuum box test (i.e. small seams around penetrations, oddball types of patches, etc.). The air lance test will be performed using a 345 kPa (50 psig) jet of air regulated and directed through a 5 mm (3/16 inch) diameter nozzle, applied to the upper edge of an overlapped seam or repaired area to detect an unbonded area. Inflation of any section of the seam by the impinging air stream shall be indicative of an unbonded area. Unbonded areas shall be repaired and retested.

#### 3.4.3 FML Inspections.

##### 3.4.3.1 Sample Field Seam Inspection.

a. Visual Inspection - Sample field seams shall be subjected to a visual inspection performed within 30 hours after the seam has been made, cured, and cooled.

b. Vacuum Box Inspection - After successful completion of the visual inspection, a vacuum box inspection shall be performed. A glass topped vacuum box which has a neoprene sealing gasket shall be used. The vacuum box test shall be performed as follows:

(1) A commercial bubble forming solution shall be applied to the area to be tested.

(2) The vacuum box shall be positioned over the area and a vacuum slowly applied until a differential pressure of 7 kPa (one psi) is achieved and held for at least 5 seconds while observing the solution for bubble formation.

(3) If the vacuum box test indicates a continuous stream of bubbles on repeated testing at the same location, then the area being tested shall be considered damaged and shall be repaired and retested.

(4) If the vacuum box test do not indicate a leak, then the vacuum shall be slowly increased until a maximum differential pressure of 14 kPa plus

0.0 or minus 2 kPa (2 plus 0.0 or minus 0.25 psi) is achieved and held for at least 20 seconds. If the test indicates a continuous stream of bubbles on repeated testing at the same location, then the area being tested shall be considered damaged and shall be repaired and retested. Care must be taken to limit the vacuum to no more than the maximum differential pressure; if it is exceeded by more than 2 kPa (0.25 psi) the FML shall be considered damaged and shall be replaced and retested.

#### 3.4.3.2 FML Initial Inspection.

A visual inspection of the FML shall be performed on each FML panel or sheet as it is unrolled. The Contracting Officer's Representative shall be notified of any visually detected damage. The visual inspection shall also verify the finished surface to be covered with the FML is properly graded and compacted.

#### 3.4.3.3 FML Seam Inspection.

Field seams shall be subjected to a visual inspection performed within 30 hours after the seam has been made, cured, and cooled. Any seams visually found to be defective shall be repaired and reinspected.

#### 3.4.3.4 Acceptance Inspection.

As soon as practicable after successful completion of the FML vacuum box test and the air lance tests, an acceptance inspection shall be performed. If the inspection reveals any defects in the work, such defects shall be repaired or the unsatisfactory work replaced before acceptance. The cost of such repairs and replacements shall be borne by the Contractor. The Contractor shall provide materials, facilities, and equipment necessary to permit adequate inspection by the Contracting Officer's Representative.

#### 3.4.4 Manufacturers Field Service.

If any problems are noticed in any inspection of a seam, the Contracting Officer's Representative shall be notified immediately. The FML manufacturer's point of contact shall also be contacted by telephone and informed that the installation of their product can not be adequately completed. After a solution has been formed, jointly between the FML manufacturer and their authorized representative, as to why the problems were encountered, another set of sample field seams shall be made and reinspected.

#### 3.4.5 Sand Cushion Tests.

Test the sand prior to installing any storage tank bottom to verify the amount of chlorides (ppm) and sulfates (ppm) and to determine the pH value of the sand. Test result shall conform to paragraph entitled "Sand Cushion".

#### 3.4.6 Tank Calibration.

After installation of the tank is complete, prepare a calibration table for the tank showing the volume of fuel in cubic meters in the tank to any height of liquid in m, and mm when measured by a steel tape lowered through the roof. Calibrate the tank in accordance with API STD 2550 for operating control. Correct the data obtained for use with the product to be stored.

3.4.7 Weld Inspection. Storage tank welds shall be tested in accordance with the requirements of API Std. 650. Inspect butt welds requiring complete penetration and complete fusion by the radiographic method.

### 3.4.8 Tightness Tests and Welding Repairs

Perform tightness tests and repairs in accordance with API STD 650, except as modified herein, prior to blast cleaning and application of the protective coating.

#### 3.4.8.1 Test of Tank Bottom

Test tank bottom immediately after completion and prior to installing any columns. Test seams in bottom of tank by applying a commercial soap film and subjecting the seam to a vacuum. Use a glass top vacuum box with hypalon or neoprene sealing gasket. Apply a commercial bubble forming solution to the weld or area to be tested; position the vacuum box over the area and slowly pull a partial vacuum. Observe the solution film for bubble formation between 0-14 kPa differential pressure. Continue to open the valve until a differential pressure of 34.5 kPa or 3.51 m of water or 259 mm of mercury is achieved and hold for at least 20 seconds while continuing to observe the solution for bubbles.

#### 3.4.8.2 Tank Shell to Bottom Inside Corner Welds

Inspect tank shell to bottom inside corner welds using the oil test. After the inside fillet weld is made, apply oil to the outside corner crevice before the outside weld is made. After 4 hours, inspect the inside fillet weld for oil penetration through defects, and correct defects. Remove oil completely prior to finishing weld joint. Then complete the remainder shell to bottom weld joint.

#### 3.4.8.3 Water Fill Tightness

Following the successful completion of the radiographic inspection of tank and internal piping welds, the tank shall be subjected to a hydrostatic water fill tightness test. The test shall include the following in sequential order:

(1) Prior to connecting water fill lines to the tank, not less than 6 equally spaced points shall be selected and marked on the ring wall. Grade elevations shall be taken at the top of the ring wall at each marked point.

(2) Water shall be flushed from the tank through each tank/pipe connection into the diked area to ensure any accumulated dirt and sediment is not flushed into the tank.

(3) The tank shall be filled in four increments equal to twenty-five percent of total capacity. At the end of each fill increment, two hours shall pass before grade elevations are taken at the top of the ring wall at each marked point. The tank shall also be visually inspected for leakage. Settlement values shall be calculated from the elevation differences. The appearance of damp spots shall be considered evidence of leakage, the Contracting Officer shall be notified and the water removed immediately. Defects found during the test shall be corrected and the tank retested.

(4) The tank shall be maintained full of water until the settlement of the tank stabilizes or a period not less than 24 hours. After the water is removed, obtain grade elevations and determine settlement at each of the marked ring wall locations.

(5) The tank shall be emptied by draining the water into the sanitary sewer.

(6) The tank bottom shall be inspected for standing water. No standing water shall be allowed anywhere on the sloped floor. If action has to be taken to correct standing water the water fill test shall again be conducted.

#### 3.4.8.4 Stripping Line

Test stripping line from sump, product inlet line, and product outlet line with water at 345 kPa (50 psi).

#### 3.4.9 Fill Test

Fill test the tank using fuel.

Tank piping and appurtenances shall be ready for service. The Government will provide the necessary fuel and labor to fill the tank with fuel. Advise the Contracting Officer's Representative, in writing, at least 10 days in advance of the need for this service. Fill tank half full and check that drain valves are closed and check tank for leaks. Keep tank half full the first 12 hours of test, then fill tank to full capacity and check that drain valves are closed and check tank for leaks. Monitor tank level hourly during the first 24 hours of the fill test and notify the Contracting Officer's Representative immediately of any leaks detected. Padlock drain valves closed for the duration of the test and provide one set of keys to the Contracting Officer's Representative. After the temperature of the fuel has become stabilized, take daily readings of the fuel level for a period of 10 days. If there is no measurable drop in the fuel level during this period, the tank will be accepted. If leakage becomes apparent during the filling or the test period, immediately notify the Contracting Officer's Representative and Government personnel will pump the fuel from the tank. Upon the acknowledgment of a leak, the Contracting Officer shall be notified immediately, the fuel shall be removed, the fuel vapor within the tank shall be removed, the tank interior and the tank site shall be cleaned, all defects corrected, and the fill test repeated. In the event fuel is removed from the tank, the internal coating system shall be visually inspected for damage before the tank is refilled. Repair defects found and repeat fill tests.

#### 3.4.10 Piping Tests

##### 3.4.10.1 Fuel Piping

Fuel piping shall be subjected to a pneumatic test. The water content of the air used for testing shall be no more than 20 percent relative humidity at 70 degrees F dry bulb. Dehumidifying equipment shall be provided on the suction or discharge side of the air compressor used to provide air for testing. Piping shall have pneumatic pressure applied at 15 psig and held for at least 4 continuous hours. Apply a commercial bubble forming solution to weld areas and carefully observe the solution film for bubble formation. During testing there shall be no bubbles or drop in pressure in the line except allowances shall be made for thermal expansion and contraction. In the event leaks are detected, the line shall be repaired and re-tested. Upon completion of satisfactory tests, the pressure shall be relieved, and the line immediately sealed. Suitable provision shall be made to prevent displacement of the piping during testing.

##### 3.4.10.2 High Liquid Level Alarm Test.

Each storage tank shall be initially overfilled with the appropriate product in order to verify the high liquid level alarms in the remote alarm panel function as designed. The initial overfill shall also verify that the storage tank overfill protection device functions as designed. Tank overfill shall stop immediately once the overfill device operates. The Contractor shall not overfill any storage more than 90 percent level even if the leak detection and liquid level electronic panel and the overfill device do not function as designed. Any problems with the electronic panel or the overfill devices

shall be corrected and retested. The system shall be drained below the high liquid levels following all tests.

#### 3.4.10.3 Miscellaneous Level Alarms

Test and verify suitable functioning of high level floats and/or alarms. Compare stick level readings with float gauges and/or float switches for all liquid level detection devices and make any necessary adjustments. Confirm operation of HLA and HHLA and LLA visual and audible alarms and make any necessary adjustments. Verify automatic activation of sump pumps SP-1 and SP-2 at the indicated liquid level depth and make necessary adjustments.

#### 3.4.11 Retesting

Deficiencies found shall be rectified and work effected by such deficiencies shall be completely retested at the Contractor's expense.

### 3.5 INSPECTIONS

#### 3.5.1 Storage Tank.

3.5.1.1 Visual Inspection of Welds. Following the tank construction, each tank welded joint shall be visually inspected for defects. Welds with excess convexity and overlap shall be have excess metal removed. Welds with excess concavity, that are undersized, or show undercutting shall be cleaned and additional metal added. Welds with excess porosity, inclusions, lack of fusion, or incomplete penetration shall have the defective portions removed and re-welded. Cracks in a weld or a tank plate shall be removed by cutting around the entire crack and re-welding the defect. Welds with poor fit-up shall be cut apart and re-welded.

#### 3.5.1.2 Radiographic Inspections.

Radiographic inspection procedures shall be in accordance with API Std 650. Interpretation of inspection results and limitations on the imperfections in the welds shall be in accordance with ASME B31.3, Chapter VI, Normal Fluid Service. Weld ripples or surface irregularities that might mask or be confused with the radiographic image of any objectionable defect shall be removed by grinding or other suitable mechanical means. The weld surface shall be merged smoothly with the base metal surface. Defective welds shall be repaired and followed with a new radiographic inspection to the newly repaired area. The use of force (peening) or foreign materials to mask, fill in, seal, or disguise any welding defects shall not be permitted.

#### 3.5.2 Piping

##### 3.5.2.1 Visual Inspection of Welds

Following the piping inspection, each piping welded joint shall be visually inspected for defects. Welds with excess convexity and overlap shall be have excess metal removed. Welds with excess concavity, that are undersized, or show undercutting shall be cleaned and additional metal added. Welds with excess porosity, inclusions, lack of fusion, or incomplete penetration shall have the defective portions removed and re-welded. Cracks in a weld or a tank plate shall be removed by cutting around the entire crack and re-welding the defect. Welds with poor fit-up shall be cut apart and re-welded.

3.5.2.2 Radiographic Inspections. Product piping welds performed at the job site shall be examined randomly by radiographic tests as defined in Section 15052 WELDING PRESSURE PIPING. Procedures and test result interpretation shall be as specified in Section 13202.

### 3.6 CLEANING AND ADJUSTING

### 3.6.1 Tank Interior

After completion of the tank coating but prior to the floating pan tests, interior surfaces within the tank shall be cleaned to eliminate any foreign matter such as water, dirt, debris, grease, oils, etc.

### 3.6.2 Tank Calibration

#### 3.6.2.1 Tank Strapping

Tank strapping shall be performed on each storage tank and be performed in strict accordance with applicable recommendations and requirements of the API Std 2550. Circumferential measurements shall be determined by the current operations or critical measurements method, as defined by API Std 2550.

#### 3.6.2.2 Gauge Table

A gauge table shall be provided for each tank based on the tank strapping results. The gauge table shall read in feet and inches with the smallest increment of measure being 1/8-inch. Table shall indicate the capacity of the tank in gallons to the nearest gallon for each 1/8-inch increment when measured by a steel tape lowered through the roof at the manual gauge well. The master gauge table shall be typed on tracing cloth or other transparency suitable for reproduction. The gauge table shall be certified for accuracy by the firm which prepared the table and the installation Contractor.

### 3.6.3 Final Adjustments

Following system completion but prior to the demonstration, the entire system shall be adjusted to meet final design requirements. Each electronic level sensing alarm shall be tested for proper operation. Fuel level gauges shall be adjusted and calibrated in accordance with the manufacturer's instructions. Calibration of level gauges shall be supervised by a manufacturer's representative. The tank's water draw-off system shall be tested to verify proper operation. The draw-off system shall be filled with a water and fuel mixture. The separation of the water and fuel shall be verified through the system's sight glass.

## 3.7 DEMONSTRATIONS

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 24 hours of normal working time and start after the system is functionally completed but prior to final system acceptance. The field instructions shall cover all of the items contained in the operation and maintenance manuals as well as demonstrations of routine maintenance operations.

END OF SECTION

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## SECTION 13410

## AUTOMATED FUELS MANAGEMENT SYSTEM (AFMS)

## 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.

## CODE OF FEDERAL REGULATIONS (CFR)

47 CFR Part 18 (1997) Telecommunication; Industrial, Scientific, and Medical Equipment

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

UL 50 (1995) UL Standard for Safety Enclosures for Electrical Equipment

UL 1238 (1996) UL Standard for Safety Control Equipment for Use with Flammable Liquid Dispensing Devices

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown.

## 1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of work and verify all dimensions in the field so that all equipment shall be properly located. If any conflicts occur necessitating departure from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

## 1.2.3 Hazardous Locations

Wiring in hazardous locations shall conform to requirements of NFPA 70.

## 1.2.4 Standard Products

Material and equipment shall be a 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.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

## Data

### Manufacturer's Catalog Data; FIO

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 and Equipment List; FIO

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 item.

### Installation Procedures; FIO

As a minimum, installation procedures for the fuel management units. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

### Test Procedures; GA

Detailed test procedures and checklist for the automated fuel management system 30 days prior to performing system tests.

### Training; FIO

Lesson plans and training data, in manual format, for the training course.

## Drawings

### Automated Fuel Management System; FIO

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, manufacturer's standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract documents. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the contract 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 shall be coordinated and included as a single submission. Multiple submissions for the same equipment or system are not acceptable.

### As-Built Drawings; FIO

As-build drawings shall be provided as required by Section 01702 AS-BUILT RECORDS AND DRAWINGS.

## Reports

### Tests and Measurements; FIO

Test reports in booklet form tabulating all field tests, measurements, and calibrations performed, within 2 weeks after completion and testing of the installed system.

## Operation and Maintenance Manuals

## Operation and Maintenance Manuals; GA

Six copies of operating instructions outlining step-by-step procedures required for system start-up, operation, and shutdown. The instruction shall include manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout, and simplified wiring and control diagrams of the system installed. Instructions shall be approved prior to training.

### 1.4 OPERATIONAL ENVIRONMENT

1.4.1 All components that are located outdoors and exposed to the elements shall function normally within an ambient temperature range of -60° Fahrenheit to +140° Fahrenheit.

1.4.2 All components that are located indoors and not exposed to the elements shall function normally within an ambient temperature range of -58° Fahrenheit to +105° Fahrenheit and relative humidity from 20 to 80 percent.

1.4.3 All components that are located outdoors shall function normally in conditions of rain, blowing dust or snow within the specified operating temperature range.

### 1.5 SAFETY

1.5.1 Instructions. All decals, instructions, and placards required for purposes of safe operation or as a precaution, shall be displayed as required.

1.5.2 Approval. All line voltage components shall be recognized by an approved national testing house such as Underwriters Laboratory or ETL Testing Laboratories.

1.5.3 Electromagnetic Radiation. System components must comply with the requirements of Part 18 of the Federal Communications Commission Rules and Regulations, CFR Title 47 as to electromagnetic radiation limitations.

1.5.4 Location of Components. Each fueling hose on a fueling Island must be located within 7.62 meters of the fuel management unit that controls it. The controlling fuel management unit must be located on the same fueling island as the hose it controls. Each fueling island must have its own fuel management unit so as to preclude the necessity of personnel crossing active traffic lanes in order to reach fueling hoses activated by a particular fuel management unit.

## PART 2 PRODUCTS

### 2.1 CENTRAL CONTROLLER.

The Central Controller shall be a 133 Mhz Pentium (or better) IBM compatible personal computer (PC) with a minimum of 2M RAM which operates on NT 4.0 (or higher) operating system. It shall have a hard disk drive with a minimum of fifteen (14) megabytes of memory available for the Central Controller program and additional memory for storage of transaction data. A CD ROM drive, 3¼" floppy drive, and a Hayes compatible 33.6 kbps internal modem are required. A parallel printer port shall be provided for an access device encoder and another for a transaction printer. The system shall be year 2000 (Y2K) compliant.

2.1.1 Access Device (Key) Encoder. The System shall have an encoder for the access device. It shall interface to the Central Controller via a parallel communications port. It shall include a power-on light and a power supply. It shall be capable of writing data to the access device from the Central Controller.

2.1.2 System Components Capabilities. The Central Controller shall be capable of storing and operating a menu driven software program. The software shall be provided with the Central Controller. The program shall perform the following functions:

2.1.2.1 Allow for entry of Information specific to each vehicle using the System. Information shall include the following:

- a. Vehicle Registration
- b. Lockout (0-9)
- c. Customer ID Code
- d. Type Issue/Defuel Code
- e. Organization Code

2.1.2.2 Allow for entry and maintenance of information specific to each fuel or other product used in the system. Information shall include:

- a. product description and code
- b. unit of measurement

2.1.2.3 Allow for the entry and maintenance of information specific to each site in the system and for the inventory of each fuel or other product at each site. Information shall include:

- a. site number and telephone number
- b. product number
- c. Julian date roll over time

2.1.2.4 Allow for the entry and maintenance of information specific to the security of the system. Capabilities shall include:

- a. authorization or exclusion of any vehicle or Central Controller operator in the system
- b. encoding of vehicle and supervisor keys for the system
- c. backing up transaction data to 3¼" floppy disks

2.1.2.5 Allow for the entry and maintenance of information, specific to communications within the system. Capabilities shall include:

- a. automatic and/or manual downloading of all sites In the System
- b. automatic and/or manual uploading of the updated unauthorized key list information to each site in the System
- c. transfer or transaction data file to the FAMS (Fuel Accounting Management system) program.

2.1.2.6 Allow for the generation of specific reports based on system data through the FAMS program. Capabilities shall include:

- a. totals by product quantities
- b. list of transactions sorted by various parameters
- c. status report on unauthorized vehicle
- d. configuration report by site
- e. inventory report by site

2.1.2.7 Allow for the setting of the site operating configurations from the Central Controller.

2.1.2.8 Allow for the setting of the Central Controller operating configurations. Allow for the accumulation of transactions that are less than a whole unit of measurement. These partial unit quantity transactions shall be accumulated under the vehicle number to which they are issued. At such time as transaction data is forwarded to the Central Controller, the partial unit transactions shall be consolidated into whole unit transactions and forwarded. Any residual partial unit transactions shall be retained, under the vehicle number it was issued to, in memory until the next consolidation.

### 2.1.3 Transaction Printer

A printer shall be provided for hard copies of transaction, attempted transactions, power failure, and system status/error records. Records shall be printed on 216mm by 279mm (8½ x 11) pages.

## 2.2 FUEL MANAGEMENT UNIT (FMU)

The fuel management unit shall be a stand alone unit mounted on the fueling island in the proximity of the fuel dispensers. It shall consist of the following components:

### 2.2.1 Cabinet and Pedestal

The electronics enclosure is of aluminum construction with hinged, key-locking access doors. It has an anti-solar radiation shield with all exposed areas painted. The electronics enclosure shall be mounted on top of an aluminum pedestal. The pedestal shall have a hinged and keyed locking door and a surface mounting flange.

### 2.2.2 Display

The unit shall have a liquid crystal display. The display shall support two lines of 40 characters each. The display shall be a top view style of industrial grade with transflective positive image and EL lamp backlight with sun shade.

### 2.2.3 Modem

The unit shall have a Hayes compatible 33.6 kbps internal modem.

### 2.2.4 Manual Override

The unit shall have a manual override switch for each hose it controls that will allow fuel to be dispensed from that hose when the unit is inoperative. Access to the manual override switches by the user shall be restricted.

### 2.2.5 Keypad

The unit shall have a 16 character keypad with a 101.6mm by 101.6mm face. Characters include: numbers 0-9, ENTER and CLEAR keys, and alpha letters A-D.

### 2.2.6 Power Requirements

The unit shall operate on 120 volts AC, 60 Hz, 15 amp power circuit (or 220 volts AC, 50/60 Hz, 15 amps).

2.2.7 The fuel management unit shall be capable of storing and running a program that shall allow for:

- a. Automatic power fail recovery. On power failure, the unit shall provide for termination of all transactions in progress and conversion of data to transactions that will be retained by the unit for at least five years or until power is restored and the transactions shall be downloaded to the Central Controller. When power is re-stored to the unit, it shall automatically resume operations without any manual Intervention.
- b. Verification of any access device against a data file of unauthorized access devices periodically uploaded from the Central Controller.
- c. Use of a Supervisor Key. A specially encoded key shall be provided that will allow supervisory personnel to access the unit and to set unit configuration parameters on site.
- d. Simultaneous control of up to eight fueling hoses. Unit shall allow access to an additional fueling hose as soon as the user has accessed the hose previously selected.
- e. Measurement of all transactions in tenths (or hundreds) of unit.
- f. Storage of up to 1,700 transactions between downloads by the Central Controller.
- g. Communications with the Central Controller via telephone modem over Category 3, voice grade, telephone lines, and communications with satellite fuel management units via fiber optic links
- h. Control of up to eight satellite units with up to eight fueling hoses per satellite in addition to the eight fueling hoses it directly controls.
- i. Setting unit configuration parameters as follows:
  - Hose Number: Assign an identification number to each fueling hose.
  - Product Code (by hose): Assign a product code to each hose.
  - Pulser Divide Rate: Set the number of pulses transmitted per unit of measure @ 10:1, 100:1, or 1000-1.
  - No-pulse timeout: Sets time for first pulse to be received before transaction is canceled.
  - Key reading Timeout: Sets time for the key to be inserted and read by the unit from 0 to 99 seconds.
  - Pump Finish Time-out: Sets time for the fueling hose to be deactivated after last pulse is received from 0 to 99 seconds.
  - Display Message Duration: Sets duration that prompts messages are displayed on the LED from 4 to 10 seconds.
  - Modem Answer Time Sets window in which modem will answer a call from the Central Controller from 0 to 24 hours.
  - Set Julian Date Rollover: Allows Julian Date Rollover to be set into the unit configuration file.

2.2.8 Unit Self-diagnostics. The unit shall perform diagnostics by access with the supervisor key. The self-diagnostics shall include:

- a. Pump activation signals test
- b. Read contents of a key
- c. Pulser count test
- d. Power fail recovery test
- e. Manual mode switch test
- f. Keypad test

2.2.9 Receipt Printer. The FMU shall include a receipt printer.

### 2.3 ACCESS DEVICE (KEY)

The System access device shall be a durable electronically programmable device with 1024 bits of memory capacity. It shall be capable of having data written to it and of the data being read from it by the fuel management unit. It shall have a 100,000 cycle write/erase life-span. It shall have provisions for fastening to a vehicle key ring and shall be available in several different colors for purposes of identifying special uses.

### 2.4 ACCESS DEVICE (GSA CARD)

A second system access device shall be a GSA card. The FMU shall have an insertion/withdraw type magnetic card reader for reading the magnetic strip GSA card.

## PART 3 EXECUTION

### 3.1 INSTALLATION

The automated fuel management system shall be installed as shown and in accordance with the manufacturer's diagrams and written recommendations, unless otherwise specified.

#### 3.1.1 Overvoltage and Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

### 3.2 TRAINING

A training course shall be provided for the operations and maintenance staff. The course shall be conducted where the system is installed or as directed by the Contracting Officer. The training period shall consist of 1 training day (8 hours per day) and shall start after the system is functionally complete but prior to final acceptance tests. The instruction shall cover all of the items contained in the operating and maintenance instructions.

### 3.3 TESTING

The Contractor shall notify the Contracting Officer 30 days before the acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures and in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is

functional. A checklist will be verified by both the Contractor and the system manufacturer as to the completeness and functionality of the System.

END OF SECTION

## SECTION 15052

## WELDING PRESSURE PIPING

## 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 Z49.1 (1988) Safety in Welding and Cutting

## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT-01 (1988) Recommended Practice SNT-TC-1A

ASNT-02 (1980) Question and Answer Book A: Radiographic Test Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)

ASNT-03 (1980) Question and Answer Book B: Magnetic Particle Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)

ASNT-04 (1980) Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)

ASNT-05 (1980) Question and Answer Book D: Liquid Penetrant Testing Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME-01 (1989; Addenda 1989, 1990) Boiler and Pressure Vessel Code; Section I, Power Boilers

ASME-04 (1989; Addenda 1989, 1990) Boiler and Pressure Vessel Code; Section II, Material Specifications, Part C - Welding Rods, Electrodes and Filler Metals

ASME-14 (1989; Addenda 1989, 1990) Boiler and Pressure Vessel Code; Section V, Nondestructive Examination

ASME-17 (1989; Addenda 1989, 1990) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASME B31.1 (1989) Power Piping

ASME B31.3 (1990) Chemical Plant and Petroleum Refinery Piping

## AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1986) Symbols for Welding, Brazing and Nondestructive Examination

- AWS A3.0 (1989) Standard Welding Terms and Definitions
- AWS D10.9 (1980) Qualification of Welding Procedures and Welders for Piping and Tubing
- AWS QC1 (1988) Qualification and Certification of Welding Inspectors

## 1.2 DEFINITIONS

Definitions shall be in accordance with AWS A3.0.

## 1.3 GENERAL REQUIREMENTS

This section covers the welding of pressure piping systems. Deviations from applicable codes, approved procedures, and approved detail drawings will not be permitted without prior written approval. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise specified. Procedures shall be developed by the Contractor for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing shall be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. Costs of such testing shall be borne by the Contractor. The Contracting Officer shall be notified at least 24 hours in advance of the time and place of the tests. When practicable, the qualification tests shall be performed at or near the worksite. The Contractor shall maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination by the Contracting Officer. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. ASME B31.3 requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

## 1.4 PERFORMANCE

The Contractor shall be responsible for the quality of all joint preparation, welding, and examination. All materials used in the welding operations shall be clearly identified and recorded. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when he deems it necessary to achieve the quality required.

## 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 DESCRIPTIONS:

Data Qualifications; FIO.

Welding procedure qualification.

Drawings Pressure Piping; FIO.

Detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required.

Certificates Qualifications; FIO.

Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

Records Welding Operations; FIO.

Detailed procedures which define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

## 1.6 QUALIFICATIONS

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification, provided that all of the following conditions are fulfilled:

a. Copies of the welding procedures, the procedure qualification test records, and the welder and welding operator performance qualification test records are submitted and approved in accordance with the paragraph SUBMITTALS.

b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality assurance organization.

c. The welding procedures, welders, and welding operators were qualified in accordance with ASME-17, or AWS D10.9, AR-2 level; and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this specification.

d. The requirements of paragraph "Renewal of Qualification" below are met and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

### 1.6.1 Welding Procedures Qualification.

The Contractor shall record in detail and shall qualify the Welding Procedure Specifications for every welding procedure that he proposes. Qualification for each welding procedure shall conform to the requirements of ASME B31.1 and to this specification. The welding procedures shall specify end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by approved welding procedures, unless otherwise indicated or specified. The type of backing rings or consumable inserts, if used, shall be described and if they are to be removed, the removal process shall be described. Copies of the welding procedure specifications and procedure qualification test results for each type of welding required shall be submitted in accordance with paragraph SUBMITTALS. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedures shall be identified individually and shall be referenced on the detail drawings or keyed to the contract drawings.

### 1.6.2 Welder and Welding Operator Performance.

Each welder and welding operator assigned to work shall be qualified in accordance with ASME B31.

#### 1.6.2.1 Certification

Before assigning welders or welding operators to the work, the Contractor shall provide the Contracting Officer with their names together with certification that each individual is performance-qualified as specified. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

#### 1.6.2.2 Identification

Each welder or welding operator shall be assigned an identifying number, letter, or symbol that shall be used to identify all of his welds. To identify welds, written records indicating the location of welds made by each welder or welding operator shall be submitted, and each welder or welding operator shall apply his mark adjacent to his welds using a rubber stamp or felt-tipped marker with permanent, weatherproof ink or other methods approved by the Contracting Officer that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3-foot intervals. Identification by die stamps or electric etchers will not be allowed.

#### 1.6.2.3 Renewal of Qualification.

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. When a welder or welding operator has not used the specific welding process for a period of 3 months; the period may be extended to 6 months if he has been employed on some other welding process.

b. When a welder or welding operator has not welded with any process during a period of 3 months, all his qualifications shall be expired, including any extended by virtue of a., above.

c. There is specific reason to question his ability to make welds that will meet the requirements of the specifications.

d. 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 preceding 12 months.

e. Renewal of qualification for a specific welding process under conditions a., b., and d., above, need be made on only a single test joint or pipe of any thickness, position, or material to reestablish the welder's or welding operator's qualification for any thickness, position, or material for which he had previously qualified.

#### 1.6.3 Inspection and NDE Personnel

All inspection and NDE personnel shall be qualified in accordance with the following requirements.

##### 1.6.3.1 Inspector Certification.

Welding inspectors shall be qualified in accordance with AWS QC1.

##### 1.6.3.2 NDE Personnel.

NDE personnel shall be certified, and a written procedure for the control and administration of NDE personnel training, examination, and certification shall be established. The procedures shall be based on appropriate specific and

general guidelines of training and experience recommended by ASNT-01, ASNT-02, ASNT-03, ASNT-04, and ASNT-05.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

All filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to insure safe handling.

##### 1.7.1 Material Control

Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

##### 1.7.1.1 Damaged Containers

Low-hydrogen steel electrodes shall be stored in their sealed shipping container. If the seal is damaged during shipment or storage, and the damage is not immediately detected, the covered electrodes in that container shall be rebaked in accordance with the manufacturer's instructions prior to issuance or shall be discarded. If a container is damaged in storage and the damage is witnessed, the electrodes from that container shall be immediately placed in a storage oven. The storage oven temperature shall be as recommended by the manufacturer or the welding material specification.

##### 1.7.1.2 Partial Issues

When a container of covered electrodes is opened and only a portion of the content is issued, the remaining portion shall, within one-half hour, be placed in a storage oven.

##### 1.7.2 Damaged Materials

Materials which are damaged shall be discarded. All covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire shall be discarded.

#### 1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4.

#### 1.9 SAFETY

Safety precautions shall conform to ANSI Z49.1.

### PART 2 PRODUCTS

#### 2.1 WELDING MATERIALS

Welding materials shall comply with ASME-04. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

## PART 3 EXECUTION

### 3.1 WELDING OPERATIONS

Welding shall be performed in accordance with qualified procedures using qualified welders and welding operators. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer shall determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members shall conform to Section 05055 WELDING, STRUCTURAL.

#### 3.1.1 Base Metal Preparation.

Oxy-fuel cutting shall not be used on austenitic stainless steel or nonferrous materials.

#### 3.1.2 Weld Joint Fit-Up.

Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. Welded temporary attachments shall not be used except when it is impractical to use mechanical fixtures. When temporary attachments are used, they shall be the same material as the base metal, and shall be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment shall be cut to not less than 1/4 inch from the member and the balance removed by grinding. After the temporary attachment has been removed, the area shall be visually examined.

#### 3.1.3 Preheat and Interpass Temperatures.

Preheat temperatures shall meet the requirements specified by ASME B31. However, in no case shall the preheat be below 50 degrees F for ferritic steel or austenitic stainless steel, or 32 degrees F for nonferrous alloys. The maximum interpass temperatures shall not exceed 300 degrees F for austenitic stainless steels, nickel alloys, and copper alloys; and 500 degrees F for carbon steels. Preheat techniques shall be such as to insure that the full thickness of the weld joint preparation and/or adjacent base material, at least 3 inches in all directions, is at the specified temperature. Preheating by induction or resistance methods is preferred. When flame heating is used, only a neutral flame shall be employed. Oxy-fuel heating shall not be used on austenitic stainless steel or nickel-alloy materials; however, air-fuel heating is acceptable if controlled to insure that the surface temperature does not exceed 150 degrees F. Interpass temperatures shall be checked on the surface of the component within 1 inch of the weld groove and at the starting location of the next weld pass, and for a distance of about 6 inches ahead of the weld, but not on the area to be welded.

#### 3.1.4 Production Welding Instructions.

a. Welding shall not be done when the ambient temperature is lower than 0 degree F.

b. Welding is not permitted on surfaces that are wet or covered with ice, when snow or rain is falling on the surfaces to be welded, or during periods of high winds, unless the welders and the work are properly protected.

c. Gases for purging and shielding shall be welding grade and shall have a dew point of minus 40 degrees F or lower.

d. Back purges are required for austenitic stainless steels and nonferrous alloys welded from one side and shall be set up such that the flow of gas from the inlet to the outlet orifice passes across the area to be welded. The oxygen content of the gas exiting from the purge vent shall be less than 2 percent prior to welding.

e. The purge on groove welds shall be maintained for at least three layers or 3/16 inch.

f. Removable purge dam materials shall be made of expandable or flexible plugs, such as plexiglass, plywood (which shall be dry when used), etc. Wood dams shall be kiln-dried quality. Nonremovable purge dams and purge dam adhesives shall be made of water soluble materials. Purge dams shall not be made of polyvinyl alcohol.

g. Any welding process which requires the use of external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall be of material and shape appropriate to reduce wind velocity in the vicinity of the weld to a maximum of 5 mph (440 fpm).

h. Welding of low-alloy and hardenable high-alloy steels may be interrupted provided a minimum of at least 3/8-inch thickness of weld deposit or 25 percent of the weld groove is filled, whichever is greater, and the preheat temperature is maintained during the time that welding is interrupted. If the temperature falls below the minimum preheat temperature before all welding has been completed on a joint, or, where required, before post weld heat treatment, a liquid penetrant or magnetic particle examination shall be performed to insure sound deposited metal before reheating. Welding of other materials may be interrupted without restriction provided a visual inspection is performed before welding is resumed.

i. Tack welds to be incorporated in the final welds shall have their ends tapered by grinding or welding technique. Tack welds that are cracked or defective shall be removed and the groove shall be retacked prior to welding. Temporary tack welds shall be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable high-alloy steels, the area shall be magnetic particle examination inspected.

j. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is required, the following requirements apply:

(1) The weld-end preps of ferritic steel components, which are to be welded to austenitic stainless steel, shall be buttered with one of the following weld filler metals and shall conform to the specified requirements:

ASME-04, SFA 5.14, Classification ERNiCr-3.  
ASME-04, SFA 5.11, Classification ENiCrFe-2.

(2) The ferritic steel weld-end prep shall be buttered, receive a postweld heat treatment as required by ASME B31 and then be machined with the applicable weld-end preparation. After machining, the buttered layer shall be a minimum of 1/4-inch thick.

(3) Pressure piping transition joints shall be completed using ERNiCr-3 or ENiCrFe-2 weld filler metals. No further postweld heat treatment shall be performed.

k. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is not required, prepare and weld the joint using either ERNiCr-3 or ENiCrFe-2 filler metals. For service temperatures of 200 degrees F or less, stainless filler metal 309 ASME-04, SFA 5.4 or 5.9 is permissible in lieu of the nickel-based alloys.

l. Grinding of completed welds is to be performed only to the extent required for NDE, including any inservice examination, and to provide weld reinforcement within the requirements of ASME B31.1. If the surface of the weld requires grinding, care shall be taken to avoid reducing the weld or base material below the minimum required thickness. Minimum weld external reinforcement shall be flush between external surfaces.

### 3.1.5 Postweld Heat Treatment.

Postweld heat treatment shall be performed in accordance with ASME B31. Temperatures for local postweld heat treatment shall be measured continuously by thermocouples in contact with the weldment. Postweld heat treatment of low-alloy steels, when required, shall be performed immediately upon completion of welding and prior to the temperature of the weld falling below the preheat temperature. However, postweld heat treatment may be postponed after the completion of the weld, if, immediately after the weld is completed, it is maintained at a minimum temperature of 300 degrees F or the preheat temperature, whichever is greater, for 2 hours per inch of weld thickness. For low-alloy steels, the cooling rates shall be such that temper embrittlement is avoided.

## 3.2 EXAMINATIONS, INSPECTIONS, AND TESTS

Visual and NDE shall be performed by the Contractor overseen to detect surface and internal discontinuities in completed welds. The services of a qualified commercial inspection or testing laboratory or technical consultant, approved by the Contracting Officer, shall be employed by the Contractor. All tack welds, weld passes, and completed welds shall be visually inspected. In addition, magnetic particle and liquid penetrant examination shall be performed on root passes. Radiographic, liquid penetrant, magnetic particle, or ultrasonic examination shall be required as indicated in TABLE I. When inspection and testing indicates defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS.

**TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS**

Type Weld	Piping Service Conditions and Nondestructive Test		
	Temperatures over 750 degrees F and at all pressures.	Temperatures between 350 degrees F and 750 degrees F inclusive and at pressures above 1,025 psig.	All others.
Butt Welds (Girth and Longitudinal)	RT for NPS over 2-inch MT or PT for NPS 2 inches and less.	RT for over 2-inch NPS with thickness over 3/4 inch. Visual for all sizes with thickness 3/4-inch or less.	Visual for all sizes and thicknesses.
Welded Branch Connections (Size indicated is branch size)	RT for NPS over 4-inch; MT or PT for NPS 4 inches and less. (See Note 7)	RT for branch over 4-inch NPS and thickness of branch over 3/4 inch. Visual for all sizes with branch thickness 3/4-inch or less.	Visual for all sizes and thicknesses.
Fillet, Socket Attachment and Seal Welds	PT or MT for all sizes and thicknesses.		Visual for all sizes and thicknesses.

## NOTES TO TABLE I

(1) All welds must be given a visual examination in addition to the specific nondestructive examination specified. (2) NPS - nominal pipe size. (3) RT - Radiographic examination; MT - magnetic particle examination; PT - liquid penetrant examination. (4) RT of branch welds shall be performed before any nonintegral reinforcing material is applied. (5) The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation. (6) Temperatures and pressures shown are design. (7) In lieu of radiography of welded branch connections when required above, liquid penetrant or magnetic particle examination is acceptable and, when used, shall be performed at the lesser of one half of the weld thickness or each 1/2 inch of weld thickness and all accessible final weld surfaces. (8) For nondestructive examination of the pressure retaining component, refer to the standards listed in applicable code or the manufacturing specifications. (9) Fillet welds not exceeding 1/4-inch throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT or MT requirements of the above table.

## 3.2.1 Random NDE Testing

When random radiographic or ultrasonic examination is required, the Contractor shall test a minimum of 10 percent of the total length or number of piping welds. The welds inspected shall be selected randomly, but the selection shall include an examination of welds made by each welding operator or welder. If the random testing reveals that any welds fail to meet minimum quality requirements, an additional 10 percent of the welds in that same group shall be inspected. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the

defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. The rejected welds shall be removed and rewelded, or the rejected welds shall be 100 percent inspected and all defective weld areas removed and rewelded.

### 3.2.2 Visual Inspection

Weld joints shall be inspected visually as follows:

a. Before welding - for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.

b. During welding - for cracks and conformance to the qualified welding procedure.

c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

### 3.2.3 NDE Testing

NDE shall be in accordance with written procedures. Procedures for radiographic liquid penetrant magnetic particle or ultrasonic tests and methods shall conform to ASME-14. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer. In addition to the information required in ASME-14, the written procedures shall include the timing of the NDE in relation to the welding operations and safety precautions.

### 3.2.4 Inspection and Tests by the Government

The Government will perform inspection and supplemental nondestructive or destructive tests as deemed necessary. The cost of supplemental NDE will be borne by the Government. The correction and repair of defects and the reexamination of weld repairs shall be performed by the Contractor at no additional cost to the Government. Inspection and tests will be performed as required for visual inspection and NDE, except that destructive tests may be required also. When destructive tests are ordered by the Contracting Officer and performed by the Contractor and the specimens or other supplemental examinations indicate that the materials and workmanship do not conform to the contract requirements, the cost of the tests, corrections, and repairs shall be borne by the Contractor. When the specimens or other supplemental examinations of destructive tests indicate that materials or workmanship do conform to the specification requirements, the cost of the tests and repairs will be borne by the Government. When destructive tests are made, repairs shall be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding shall be subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to the specification requirements, the work may be rejected at any time before final acceptance of the system containing the weldment.

## 3.3 ACCEPTANCE STANDARDS

### 3.3.1 Visual

The following indications are unacceptable:

a. Cracks.

- b. Undercut on surface which is greater than 1/32-inch deep.
- c. Weld reinforcement greater than 3/16 inch.
- d. Lack of fusion on surface.
- e. Incomplete penetration (applies only when inside surface is readily accessible).
- f. Convexity of fillet weld surface greater than 10 percent of longest leg plus 0.03 inch.
- g. Concavity in groove welds.
- h. Concavity in fillet welds greater than 1/16 inch.
- i. Fillet weld size less than indicated or greater than 1-1/4 times the minimum indicated fillet leg length.

### 3.3.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

- a. Any cracks and linear indications.
- b. Rounded indications with dimensions greater than 3/16 inch.
- c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
- d. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

### 3.3.3 Liquid Penetrant Examination

Indications whose major dimensions are greater than 1/16 of an inch shall be considered relevant. The following relevant indications are unacceptable:

- a. Any cracks or linear indications.
- b. Rounded indications with dimensions greater than 3/16 inch.
- c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
- d. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

### 3.3.4 Radiography

Welds that are shown by radiography to have any of the following discontinuities are unacceptable:

- a. Porosity in excess of that shown as acceptable in the ASME-01, Appendix A-250.
- b. Any type of crack or zone of incomplete fusion or penetration.

c. Any other elongated indication which has a length greater than:

(1) 1/4 inch for t up to 3/4 inch inclusive, where t is the thickness of the thinner portion of the weld.

(2) 1/3 t for t from 3/4 inch to 2-1/4 inch, inclusive.

(3) 3/4 inch for t over 2-1/4 inch.

d. Any group of indications in line that have an aggregate length greater than t in a length of 12t, except where the distance between the successive indications exceeds 6L where L is the longest indication in the group. Where t pertains to the thickness of the weld being examined; if a weld joins two members having different thickness at the weld, t is the thinner of these two thicknesses.

### 3.3.5 Ultrasonic Examination

Linear-type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

a. 1/4 inch for t up to 3/4 inch.

b. 1/3 inch for t from 3/4 inch to 2-1/4 inch.

c. 3/4 inch for t over 2-1/4 inch.

Where t is the thickness of the weld being examined; if the weld joins two members having different thicknesses at the weld, t is the thinner of these two thicknesses. Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of length.

### 3.4 CORRECTIONS AND REPAIRS

Defects shall be removed and repaired as specified in ASME B31 unless otherwise specified. Disqualifying defects discovered between weld 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 eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

END OF SECTION

## SECTION 15250

## THERMAL INSULATION FOR MECHANICAL 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. At the discretion of the government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 209	(1995) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 195	(1990) Mineral Thermal Insulating and Cement
ASTM C 449	(1995) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
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 C 647	(1995) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 795	(1992) Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C 871	(1995) Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
ASTM C 916	(1985; Rev 1990) Adhesives for Duct Thermal Insulation
ASTM C 920	(1994) Elastomeric Joint Sealants

ASTM C 921	(1989 R; 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C 1126	(1989) Specification for faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM D 3278	(1989) Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
ASTM E 84	(1995a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)	
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)	
MICA-01	(1993) National Commercial & Industrial Insulation Standards

## 1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

## 1.3 GENERAL QUALITY CONTROL

### 1.3.1 Standard Products

Materials shall be the standard products of manufacturers 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.

### 1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

### 1.3.3 Surface Burning Characteristics

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.

### 1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

#### 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:

##### Samples

Thermal Insulation Materials; FIO.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time. After approval of materials and prior to applying insulation a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA-01 plates (or detail drawings showing the insulation material and insulating system) for each pipe, duct, or piece of equipment which is/are required to be insulated per this specification. The MICA plates shall be marked-up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application. The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label which identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use. After approval of materials actual sections of installed systems properly insulated in accordance with the specification requirements shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. Display sample sections will be inspected at the jobsite by the Contracting Officer. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed. Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric unions and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services. Duct Insulation Display Sections: Display sample sections for rigid and flexible duct

insulation used on the job. A display section for duct insulation exposed to weather shall be protected by enclosing with a temporary covering.

## 1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants by the Contractor. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

#### 2.1.1 Adhesives

##### 2.1.1.1 Acoustical Lining Insulation Adhesive.

Insulation shall be applied in cut-to-size pieces attached to the interior of the duct with a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire-resistant adhesive to prevent delamination of glass fibers.

##### 2.1.1.2 Mineral Fiber Insulation Cement.

Cement shall be in accordance with ASTM C 195.

##### 2.1.1.3 Lagging Adhesive.

Lagging adhesives shall be nonflammable and fire-resistant and shall have flame spread and smoke developed ratings of 25/50 when measured in accordance with ASTM E 84. Adhesives shall be either the Class 1 or Class 2 type as defined here. Class 1 adhesive shall be pigmented white or red and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation. Class 2 adhesive shall be pigmented white and be suitable for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

##### 2.1.2 Contact Adhesive.

Adhesive may be dispersed in a nonhalogenated organic solvent with a low flash point (flash point less than minus 3.9 degrees C (25 degrees F) when tested in accordance with ASTM D 3278) or, dispersed in a nonflammable organic solvent which shall not have a fire point below 94 degrees C. (200 degrees F.) The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not omit nauseous,

irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 100 degrees C. (212 degrees F.) The adhesive shall be nonflammable and fire resistant.

### 2.1.3 Caulking.

ASTM C 920, Type S, Grade NS, Class 25, Use A.

### 2.1.4 Corner Angles.

Nominal 0.4060 mm (0.016 inch) aluminum 25 by 25 mm (1 by 1 inch) with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

### 2.1.5 Finishing Cement.

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449.

### 2.1.6 Fibrous Glass Cloth and Glass Tape.

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Fibrous glass cloth and tape; 20 by 20 maximum size mesh. Tape shall be 100 mm (4 inch) wide rolls. Class 3 tape shall be 0.15 kg per square meter. (4.5 ounces per square yard.)

### 2.1.7 Staples.

Outward clinching type monel ASTM A 167, Type 304 or 316 stainless steel.

### 2.1.8 Jackets.

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 6.1 N/mm (35 pounds/inch) width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 3.5 N/mm (20 pound/ inch) width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

### 2.1.9 Vapor Retarder Coating.

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall not exceed 0.05 perm and shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. The flash point of the compound shall not be less than 26.7 degrees C (80 degrees F) and shall be determined in accordance with ASTM D 3278. All other application and service properties shall be in accordance with ASTM C 647.

### 2.1.10 Wire.

Soft annealed ASTM A 580 Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

## 2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be as follows:

### 2.2.1 Aboveground Cold Pipeline.

Insulation for minus 34 degrees C to plus 16 degrees C (minus 30 degrees to Plus 60 degrees F) shall be as follows:

#### 2.2.1.1 Cellular Glass.

ASTM C 552, Type II, and Type III.

#### 2.2.1.2 Flexible Cellular Insulation.

ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.

#### 2.2.1.3 Phenolic Insulation.

ASTM C 1126, Type III. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

### 2.2.2 Aboveground Hot Pipeline.

For aboveground hot pipeline above 16 degrees C (60 degrees F) insulation the following requirements shall be met.

#### 2.2.2.1 Mineral Fiber.

ASTM C 547, Class 1 or Class 2 as required for the operating temperature range.

#### 2.2.2.2 Not Used

#### 2.2.2.3 Cellular Glass.

ASTM C 552, Type II and Type III.

#### 2.2.2.4 Flexible Cellular Insulation

ASTM C 534, Type I or II to 93 degrees C (200 degrees F) (200 degrees F) service.

#### 2.2.2.5 Phenolic Insulation.

ASTM C 1126 Type III to 121 C (250 F) service. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

### 2.2.3 Below ground Pipeline Insulation.

ASTM C 552, Type II.

## 2.3 NOT USED

## 2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be as follows:

### 2.4.1 Cold Equipment Insulation.

For temperatures below 16 degrees C. (60 degrees F.)

#### 2.4.1.1 Cellular Glass.

ASTM C 552, Type I, Type III, or Type IV as required.

#### 2.4.1.2 Flexible Cellular Insulation.

ASTM C 534, Type II.

#### 2.4.1.3 Phenolic Foam.

ASTM C 1126 Type II. A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

#### 2.4.2 Hot Equipment Insulation.

For temperatures above 16 degrees C. (60 degrees F.)

##### 2.4.2.1 Rigid Mineral Fiber.

ASTM C 612, Type 2, 3, 4 or 5 as required for temperature encountered to 982 degrees C (1800 degrees F). (1800 degrees F.)

##### 2.4.2.2 Flexible Mineral Fiber.

ASTM C 553, Type 1, 2, 3, 4, 5, 6, or 7 as required for temperature encountered to 649 degrees C (1200 degrees F). (1200 degrees F.)

##### 2.4.2.3 Not Used

##### 2.4.2.4 Cellular Glass.

ASTM C 552, Type I, Type III, or Type IV as required.

##### 2.4.2.5 Flexible Cellular Insulation.

ASTM C 534, Type II, to 93 degrees C (200 degrees F.)

##### 2.4.2.6 Phenolic Foam.

ASTM C 1126 Type II to 121 degrees C (250 degrees F.) A maximum allowable leachable chloride content shall comply with ASTM C 795 when tested in accordance with ASTM C 871.

### PART 3 EXECUTION

#### 3.1 APPLICATION - GENERAL

##### 3.1.1 Installation.

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes

dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if aforementioned cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA-01 standard plates except where modified herein or on the drawings.

### 3.1.2 Not Used

### 3.1.3 Painting and Finishing.

Painting shall be as specified in Section 09900 PAINTING, GENERAL.

### 3.1.4 Flexible Cellular Insulation.

Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 93 degrees C (200 degrees F). Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry.

### 3.1.5 Welding.

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

### 3.1.6 Pipes/Ducts/Equipment which Require Insulation.

Insulation is required, unless stated otherwise, on all pipes, ducts, or equipment, which operate at or below 15.6 C (60 F) and at or above 26.7 C (80 F).

## 3.2 PIPE INSULATION INSTALLATION

### 3.2.1 Pipe Insulation

#### 3.2.1.1 General.

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Unions in pipe above 16 degrees C. (60 degrees F.)
- e. Strainers in pipe above 16 degrees C. (60 degrees F.)

- f. Check valves in pipe above 16 degrees C. (60 degrees F.)
- g. Air chambers.

#### 3.2.1.2 Pipes Passing Through Sleeves

- a. Pipe insulation shall be continuous through the sleeve.
- b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.
- c. Where penetrating interior walls, the aluminum jacket shall extend 50 mm (2 inches) beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 250 mm (10 inches) above the floor with one band at the floor and one not more than 25 mm (1 inch) from the end of the aluminum jacket.
- e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 50 mm (2 inches) above the flashing with a band 25 mm (1 inch) from the end of the aluminum jacket.
- f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 50 mm (2 inches) beyond the interior surface of the wall.

#### 3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 50 mm (2 inches) and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 50 mm (2 inches) shall be installed.
- b. Horizontal pipes larger than 50 mm (2 inches) at 16 degrees C (60 degrees F) and above shall be supported on hangers in accordance with MSS SP-69, and Section 15400 PLUMBING, GENERAL PURPOSE.
- c. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 50 mm (2 inches) on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 25 mm (1 inch), (1 inch,) wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 9 m, (30 feet,) the weight of the pipe shall be additionally

supported with hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

d. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 38 mm, (1-1/2 inches,) and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

#### 3.2.1.4 Flexible Cellular Pipe Insulation.

Flexible cellular pipe insulation shall be tubular form for pipe sizes 150 mm (6 inches) and less. Type II sheet insulation used on pipes larger than 150 mm (6 inches) shall not be stretched around the pipe. On pipes larger than 300 mm (12 inches), adhere insulation directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

#### 3.2.2 Aboveground Cold Pipelines.

The following shall be included for aboveground cold pipelines minus 34 degrees C to plus 16 degrees C: (minus 30 degrees to plus 60 degrees F): Domestic cold and chilled drinking water.

##### 3.2.2.1 Insulation Thickness

$$T = PR [(1 + t/PR)K/k - 1]$$

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness  
Pipe Size (mm)

Type of Service larger	Runouts Material	25 mm up to 51 mm†	32 - & less	64 - 51 mm	127 - 102 mm	203 mm 152 mm	&
Cold domestic water, above and below ceilings	CG	38	38	38	38	38	38
	FC	10	10	10	10	10	10
	PF	10	10	10	10	10	10
Exposed lavatory drains	FC	13	13	13	13	19	19
	MF	13	25	25	38	38	38

Table I - Cold Piping Insulation Thickness  
Pipe Size (inches)

Type of Service larger	Runouts Material	1 in up to 2 in†	1.25 - & less	2.5 - 2 in	5 - 4 in	8 in 6 in	&
Cold domestic water, above and below ceilings	CG FC PF	1.5 3/8 3/8	1.5 3/8 3/8	1.5 3/8 3/8	1.5 3/8 3/8	1.5 3/8 3/8	1.5 3/8 3/8
Exposed lavatory drains	FC MF	0.5 0.5	0.5 1.0	0.5 1.0	0.5 1.5	3/4 1.5	3/4 1.5

LEGEND: PF - Phenolic Foam CG - Cellular Glass CS - Calcium Silicate MF - Mineral Fiber FC - Flexible Cellular

### 3.2.2.2 Jacket for Fibrous, Cellular Glass, and Phenolic Foam Insulated Pipe.

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building shown to be protected with an aluminum jacket shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 1.5 m (5 ft) level will be protected.

### 3.2.2.3 Insulation for Straight Runs (Fibrous, Cellular Glass and Phenolic Foam)

- a. Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor retarder coating at intervals not to exceed 4.5m. (15 feet.)
- b. Longitudinal laps of the jacket material shall overlap not less than 38 mm. (1-1/2 inches.) Butt strips 75 mm (3 inches) wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 100 mm (4 inch) centers if not factory self-sealing.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees C (40 degrees F) and 50 degrees C (120 degrees F) during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating. The patch shall extend not less than 38 mm (1-1/2 inches) past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating.

#### 3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall have ends thoroughly coated with a vapor retarder coating not less than 150 mm (6 inches) from each flange, union, valve, anchor, or fitting in all directions.

b. Precut, preformed insulation for placement over fittings, flanges, unions, valves, anchors, and mechanical couplings shall be used. Precut, preformed insulation shall exhibit the same properties as the adjoining pipe insulation. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation should be overlapped 50 mm (2 inches) or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow.

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of vapor retarder coating with a minimum total thickness of 1.6 mm (1/16th inch,) applied with glass tape embedded between coats. Tape seams shall overlap 25 mm (1 inch). The coating shall extend out onto the adjoining pipe insulation 50 mm (2 inches).

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 150 mm (6 inches from the insulation surface).

e. Flexible connections at pumps and other equipment shall be insulated with 15 mm (.5 inch) flexible cellular insulation, unless otherwise indicated.

f. Insulation shall be marked showing the location of unions, strainers, and check valves.

#### 3.2.2.5 Not Used

#### 3.2.3 Aboveground Hot Pipelines

For hot pipelines above 16 degrees C (60 degrees F) the following shall be included:

##### 3.2.3.1 Insulation Thickness

$$T = PR [(1 + t/PR)K/k - 1]$$

Insulation thickness for hot pipelines shall be determined using Table II.  
 LEGEND: PF - Phenolic Foam CG - Cellular Glass CS - Calcium Silicate MF -  
 Mineral Fiber FC - Flexible Cellular

Table II - Hot Piping Insulation Thickness  
 Pipe Size (mm)

Type of mm Service (degrees C) larger	Material	Runouts up to 51 mm	25 mm & less	32 - 51 mm	64 - 102 mm	127 - 152 mm	203 &
Hot domestic water supply & recirculating system (93.3 C max)	CG	38	38	38	38	38	38
	FC	13	25	25	38	38	38
	PF	13	25	25	25	25	25
	MF	13	25	25	38	38	38

Table II - Hot Piping Insulation Thickness  
 Pipe Size (inches)

Type of Service (degrees F) larger	Material	Runouts up to 2 in	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in &
Hot domestic water supply & recirculating system (200 F max)	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	0.5	1.0	1.0	1.5	1.5	1.5
	PF	0.5	1.0	1.0	1.0	1.0	1.0
	MF	0.5	1.0	1.0	1.5	1.5	1.5

### 3.2.3.2 Jacket for Insulated Pipe

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

### 3.2.3.3 Insulation for Straight Runs

- a. Insulation shall be applied to the pipe with joints tightly butted.
- b. Longitudinal laps of the jacket material shall overlap not less than 38 mm, (1-1/2 inches,) and butt strips 75 mm (3 inches) wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 100 mm (4 inch) centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees C and 49 degrees C (40 degrees and 120 degrees F) and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is nonadhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and be secured with adhesive and stapled on 100 mm (4 inch) centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 38 mm (1-1/2 inches) past the break.

f. Install flexible cellular pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives must be used. Type II sheet insulation when used on pipe larger than 150 mm (6 inches) shall not be stretched around the pipe. On pipes larger than 300 mm (12 inches), adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

#### 3.2.3.4 Insulation for Fittings and Accessories

a. The run of the line pipe insulation shall have the ends brought up to the item.

b. Insulation of the same thickness and conductivity as the adjoining pipe insulation, either premolded or segmented, shall be placed around the item abutting the adjoining pipe insulation, or if nesting size insulation is used, overlapping 50 mm (2 inches) or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 80 mm (3 inch) size shall be premolded. Insulation for elbows 80 mm (3 inch) size and larger shall be either premolded or segmented. Elbows insulated using segments shall have not less than 3 segments per elbow. Insulation may be wired or taped on until finish is applied.

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of Class 1 adhesive applied with glass tape embedded between coats. Tape seams shall overlap 25 mm. (1 inch.) Adhesive shall extend onto the adjoining insulation not less than 50 mm. (2 inches.) The total dry film thickness shall be not less than 1.6 mm (1/16 inch.)

d. Insulation terminations shall be tapered to unions at a 45-degree angle.

e. At the option of the Contractor, factory premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers.

#### 3.2.4 Piping Exposed to Weather.

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket shall be applied. PVC jacketing requires no factory applied jacket

beneath it. Flexible cellular insulation exposed to weather shall be treated in accordance with paragraph FLEXIBLE CELLULAR INSULATION.

#### 3.2.4.1 Aluminum Jacket.

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 50 mm (2 inches) at longitudinal and circumferential joints and shall be secured with bands at not more than 300 mm (12 inch) centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 16 degrees C (60 degrees F) and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 16 degrees C (60 degrees F) and below abuts an uninsulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 16 degrees C (60 degrees F) shall be sealed with a moisture retarder.

#### 3.2.4.2 Insulation for Fittings.

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of an emulsion type weatherproof mastic recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 25 mm (1 inch) and the adjoining aluminum jacket not less than 50 mm. (2 inches.) Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be used with PVC lagging and adhesive welded moisture tight.

#### 3.2.4.3 PVC Lagging.

PVC lagging shall be ultraviolet resistant and adhesive welded vapor tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

### 3.3 DUCT INSULATION INSTALLATION

The following do not require insulation: ducts within HVAC equipment, exhaust air ducts unless noted, and duct portions inside walls or floor-ceiling space in which both sides of the space are exposed to conditioned air and the space is not vented or exposed to unconditioned air.

### 3.4 EQUIPMENT INSULATION INSTALLATION

#### 3.4.1 General.

Removable insulation sections shall be provided to cover parts of equipment which must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

- a. Handholes.
- b. Boiler manholes.
- c. Cleanouts.
- d. ASME stamps.
- e. Manufacturer's nameplates.

### 3.4.2 Insulation for Cold Equipment.

Cold equipment below 16 degrees C: (60 degrees F:) Insulation shall be furnished on equipment handling media below 16 degrees C (60 degrees F) including the following:

- a. Drip pans under chilled equipment.

#### 3.4.2.1 Insulation Type.

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

- a. Equipment Handling Media Between 2 and 16 degrees C: (35 and 60 degrees F:) 50 mm (2 inch) thick cellular glass, 38 mm (1-1/2 inch) thick flexible cellular, or 25 mm (1 inch) thick phenolic foam.

#### 3.4.2.2 Not Used

#### 3.4.2.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 300 mm (12 inch) centers except flexible cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

#### 3.4.2.4 Vapor Retarder.

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1.6 mm (1/16 inch). Caulking shall be applied to parting line between equipment and removable section insulation.

### 3.4.3 Insulation for Hot Equipment.

Hot equipment above 16 degrees C: (60 degrees F:) Insulation shall be furnished on equipment handling media above 16 degrees C (60 degrees F) including the following:

- a. Water heaters.

#### 3.4.3.1 Insulation.

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium. Insulation thicknesses shall be as follows:

- a. Equipment handling steam to 103.4 kPa (15 psig) or other media to 121 degrees C (250 degrees F): 50 mm (2 inch) thick rigid mineral fiber, 50 mm (2 inch) thick flexible mineral fiber, 38 mm (1.5 inch) cellular glass, 38 mm (1.5 inch) thick phenolic

#### 3.4.3.2 Not Used

#### 3.4.3.3 Other Equipment.

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 300 mm (12 inch) centers except flexible cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

#### 3.4.4 Not Used

#### 3.4.5 Equipment Exposed to Weather.

Equipment exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building

END OF SECTION

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## SECTION 15400

## PLUMBING, GENERAL PURPOSE

## PART 1 GENERAL

## 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 CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010 (1994) Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.3 (1993; Z21.10.3a) Gas Water Heaters Vol. III Storage, With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous Water Heaters

ANSI Z21.22 (1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

ANSI Z124.1 (1987; Z124.1a; Z124.1b) Plastic Bathtub Units

## 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 74 (1996) Cast Iron Soil Pipe and Fittings

ASTM A 105 (1997) Forgings, Carbon Steel, for Piping Components

ASTM A 183 (1983; R 1990) Carbon Steel Track Bolts and Nuts

ASTM A 193 (1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 515 (1992) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

ASTM A 516 (1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

ASTM A 518 (1992) Corrosion-Resistant High-Silicon Iron Castings

ASTM A 536 (1984; R 1993) Ductile Iron Castings

ASTM A 733 (1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

ASTM A 888 (1994) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B 32 (1995b) Solder Metal

ASTM B 42 (1993) Seamless Copper Pipe, Standard Sizes

ASTM B 43 (1994) Seamless Red Brass Pipe, Standard Sizes

ASTM B 75 (1993) Seamless Copper Tube

ASTM B 88 (1995a) Seamless Copper Water Tube

ASTM B 117 (1994) Operating Salt Spray (Fog) Testing Apparatus

ASTM B 152 (1994) Copper Sheet, Strip, Plate, and Rolled Bar

ASTM B 306 (1992) Copper Drainage Tube (DWV)

ASTM B 370 (1992) Copper Sheet and Strip for Building Construction

ASTM B 584 (1993b) Copper Alloy Sand Castings for General Applications

ASTM B 641 (1993) Seamless and Welded Copper Distribution Tube (Type D)

ASTM B 813 (1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM B 828 (1992) Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings

ASTM C 920 (1994) Elastomeric Joint Sealants

ASTM C 1053 (1990) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications

ASTM D 638 (1995) Tensile Properties of Plastics

ASTM D 1004 (1994a) Initial Tear Resistance of Plastic Film and Sheet

ASTM D 1785 (1994) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D 2000 (1996) Rubber Products in Automotive Applications

ASTM D 2235 (1993a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

ASTM D 2239 (1994) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

ASTM D 2241 (1994) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D 2447 (1993) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

ASTM D 2464 (1994) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D 2466 (1994a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D 2467 (1994) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D 2485 (1991) Evaluating Coatings for High Temperature Service

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 2661 (1995) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D 2665 (1995) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D 2672 (1993; R 1995) Joints for IPS PVC Pipe Using Solvent Cement

ASTM D 2683 (1993) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

ASTM D 2737 (1993) Polyethylene (PE) Plastic Tubing

ASTM D 2822 (1991) Asphalt Roof Cement

ASTM D 2846 (1995a) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

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 3035 (1993) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

ASTM D 3122 (1993) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings

ASTM D 3138 (1993) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components

ASTM D 3139 (1989; R 1995) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D 3212 (1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D 3261 (1993) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D 3308 (1991a) PTFE Resin Skived Tape

ASTM D 3311 (1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns

ASTM D 4101 (1995a) Propylene Plastic Injection and Extrusion Materials

ASTM D 4551 (1991) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane

ASTM E 1 (1995) ASTM Thermometers

ASTM F 409 (1995) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings

ASTM F 437 (1993) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F 438 (1993) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40

ASTM F 439 (1993a) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F 441 (1995) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

ASTM F 442 (1994) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

ASTM F 477 (1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F 493 (1993a) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

ASTM F 628 (1995) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core

ASTM F 891 (1993a) Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 (1989; 90.1b; 90.1c; 90.1d; 90.1e; 90.1g; 90.1i) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2 (1991) Air Gaps in Plumbing Systems

ASME A112.6.1M (1988) Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.14.1 (1975; R 1990) Backwater Valves

ASME A112.18.1M (1996) Plumbing Fixture Fittings

ASME A112.19.1M (1994) Enameled Cast Iron Plumbing Fixtures

ASME A112.19.2M (1995; Errata) Vitreous China Plumbing Fixtures

ASME A112.19.4M (1994) Porcelain Enameled Formed Steel Plumbing Fixtures

ASME A112.21.1M (1991) Floor Drains

ASME A112.21.2M (1983) Roof Drains

ASME A112.36.2M (1991) Cleanouts

ASME B1.20.1 (1983; R 1992) Pipe Threads, General Purpose (Inch)

ASME B16.3 (1992) Malleable Iron Threaded Fittings

ASME B16.4 (1992) Cast Iron Threaded Fittings

ASME B16.5 (1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings

ASME B16.12 (1991) Cast Iron Threaded Drainage Fittings

ASME B16.15 (1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250

ASME B16.18 (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.22 (1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.23 (1992; Errata Jan 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV

ASME B16.24 (1991; Errata) Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500 and 2500, and Flanged Fittings, Class 150 and 300

ASME B16.29 (1994) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

ASME B16.39 (1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

ASME B31.1 (1995) Power Piping

ASME B31.5 (1992; B31.5a) Refrigeration Piping

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1 (1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX (1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASME CSD-1 (1995) Controls and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001 (1990) Pipe Applied Atmospheric Type Vacuum Breakers

ASSE 1002 (1964; Rev thru Apr 1986) Water Closet Flush Tank Ball Locks

ASSE 1003 (1964; Rev thru Oct 1993; Errata Dec 1993) Water Pressure Reducing Valves for Domestic Water Supply Systems

ASSE 1005 (1993) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size

ASSE 1011 (1995) Hose Connection Vacuum Breakers  
 ASSE 1012 (1995) Backflow Preventers with Intermediate Atmospheric Vent  
 ASSE 1013 (1971; Rev thru Oct 1993) Reduced Pressure Principle Backflow Preventers  
 ASSE 1018 (1977; Rev Jan 1986) Trap Seal Primer Valves Water Supply Fed  
 ASSE 1037 (1986; Rev thru Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures/F

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01 (1995) Standard Methods for the Examination of Water and Wastewater  
 AWWA B300 (1992) Hypochlorites  
 AWWA B301 (1992) Liquid Chlorine  
 AWWA C105 (1993) Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids  
 AWWA C203 (1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied  
 AWWA C606 (1987) Grooved and Shouldered Joints  
 AWWA C700 (1995) Cold-Water Meters - Displacement Type, Bronze Main Case  
 AWWA M20 (1973) Manual:Water Chlorination Principles and Practices

## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

## CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (1995) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications  
 CISPI HSN-85 (1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

## CODE OF FEDERAL REGULATIONS (CFR)

21 CFR 175 Indirect Food Additives:Adhesives and Components of Coatings

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-240 (Basic) Shower Head, Ball Joint

CID A-A-238 (Rev B) Seat, Water Closet

## COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA-02 (1995) Copper Tube Handbook

## COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1 (1992; Errata Jun 1993) Accessible and Usable Buildings and Facilities

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCCHR-01 (1993) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1993) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-44 (1996) Steel Pipe Line Flanges

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67 (1995) Butterfly Valves

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1990) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (1990) Cast Iron Swing Check Valves, Flanges and Threaded Ends

MSS SP-72 (1992) Ball Valves with Flanged or Butt-welding Ends for General Service

MSS SP-73 (1991) Brazing Joints for Copper and Copper Alloy Pressure Fittings

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

MSS SP-83 (1995) Class 3000 Steel Pipe Unions Socket-Welding and Threaded

MSS SP-84 (1990) Valves - Socket Welding and Threaded Ends

MSS SP-85 (1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

MSS SP-110 (1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01 (1993; Supple 1994) National Standard Plumbing Code

NAPHCC-02 (1993) National Standard Plumbing Code with Illustrations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1992) National Fuel Gas Code

NSF INTERNATIONAL (NSF)

NSF Std 5 (1992) Hot Water Generating Equipment

NSF Std 14 (1965; Rev Nov 1990) Plastics Piping Components and Related Materials

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1991) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G-101 (1985) Testing and Rating Procedures for Grease Interceptors

PDI WH 201 (1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J1508 (1993) Hose Clamps

UNDERWRITERS LABORATORIES (UL)

UL 174 (1996) Household Electric Storage Tank Water Heaters

## 1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

## 1.3 PERFORMANCE REQUIREMENTS

### 1.3.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL

### 1.3.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance Section 16642 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT).

## 1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center

on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

#### 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:

##### Data

Welding; FIO.

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; FIO. Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

##### Drawings

Plumbing System; GA.

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale. Electrical Schematics; FIO. Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

##### Instructions

Plumbing System; FIO.

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

##### Reports

Tests, Flushing and Sterilization; GA

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, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests; FIO.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

#### Certificates

Materials and Equipment; FIO.

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts; FIO.

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

#### Operation and Maintenance Manuals

Plumbing System; GA.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

### 1.6 REGULATORY REQUIREMENTS

#### 1.6.1 Plumbing

Plumbing work shall be in accordance with NAPHCC-01, unless otherwise stated and installed in accordance with NAPHCC-02.

### 1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## PART 2 PRODUCTS

## 2. MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF Std 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed under concrete floor slabs

### 2.1 Pipe Joint Materials

Grooved pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: ASTM A 74, AWWA C606.
- b. Coupling for Steel Pipe: AWWA C606.
- c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12) or Malleable Iron ASTM A 47, Grade 32510.
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm (1/16 inch) thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- e. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.
- f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.
- g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.
- h. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.
- i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.
- k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings: ASTM C 564.
- l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 110 degrees C (230 degrees F).
- m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.

p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.

q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.

s. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.

t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

## 2.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.
- k. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.
- l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.
- m. Thermometers: ASTM E 1.

2.3 Pipe Insulation Material. Insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 2.4 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

## 2.5 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm (2-1/2 inches) and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm (3 inches) and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer

certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	MSS SP-84
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ASSE 1001
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

#### 2.5.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

#### 2.6 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 20 mm (3/4 inch) exposed hose thread on spout and 20 mm (3/4 inch) male pipe thread on inlet.

#### 2.7 RELIEF VALVES

2.7.1 Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when

operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh) shall have 20 mm (3/4 inch) (3/4 inch) minimum inlets, and 20 mm (3/4 inch) outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW (200,000 Btuh) shall have 25 mm (1inch) minimum inlets, and 25 mm (1inch) outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

### 2.7.2 Water Temperature Control Valves

Water heater shall have a water temperature control valve. Valve shall be combination type to respond to both fluctuations in pressure and temperature. High limit stop shall be integral to the valve; valve shall be set to produce the temperature indicated under steady state conditions. A tempering type valve shall be unacceptable.

## 2.8 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC-01. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of valves, pop-up stoppers of lavatory waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 82 degrees C (180 degrees F) water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

### 2.8.1 Lavatories

Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled

## 2.9 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

## 2.10 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.813 mm (0.032 inch) thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm (2 inches). The interior diameter shall be not more than 3.2 mm (1/8 inch) over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

## 2.11 WATER HEATER

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls adjustable from 32 to 49 degrees C (90 to 120 degrees F). The thermal efficiencies and stand by heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that the storage capacity need not meet the standard loss requirement if the tank surface area is not insulated to R-12.5 and if a standing light is not used.

2.11.1 Automatic Storage Type. Heaters shall be complete with control system and shall have ASME rated combination pressure and temperature relief valve.

2.11.2 Hot-Water Storage Tanks. Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The standby heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 175 mm scale. Thermometer shall have a separable socket suitable for a 20 mm tapped opening. Tanks shall be equipped with pressure gauge. Insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 2.11.3 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 kW. The elements shall be wired so that only one element can operate at a time.

## 2.12 COMPRESSED AIR SYSTEM

Air Compressors. Air compressor unit shall be a factory-packaged assembly, including 3 phase, 460 volt motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 1 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. An intake air filter and silencer shall be provided with each compressor. Means shall be provided for draining condensed moisture from the receiver by an automatic

float type trap. Capacities of air compressors and receivers shall be as indicated.

#### 2.12.2 Air Receivers.

Receivers shall be designed for 1.38 MPa (200 psi) working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

#### 2.12.3 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 862 kPa (125 psi) capacity shall conform to manufacturer recommendation.

#### 2.12.4 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 862 kPa (125 psi) and a maximum temperature of 93 degrees C (200 degrees F). Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 kPa to 862 kPa (0 to 125 psi).

### 2.13 DOMESTIC WATER SERVICE METER

Cold water meter shall be of the positive displacement type conforming to AWWA C700. Meter register may be round or straight reading type, as provided by the local utility. Contractor shall install meter at a location approved by the Contracting Officer's Representative.

## PART 3 EXECUTION

### 3. GENERAL INSTALLATION REQUIREMENTS

Hubless cast-iron pipe shall not be installed under concrete floor slabs. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m (5 feet) outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 150 mm (6 inches) above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm (12 inches) below the average local frost depth. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with actuator above the valve body.

#### 3.1 Water Pipe, Fittings, and Connections

### 3.1.1 Utilities

3.1.1.1 The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

### 3.1.2 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

### 3.1.3 Mains, Branches, and Runouts

3.1.3.1 Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 15 mm (1/2 inch) between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

### 3.1.3.2 Pipe Drains

Pipe drains shall consist of 20 mm (3/4 inch) hose bibb with renewable seat and gate valve ahead of hose bibb. At other low points, 20 mm (3/4 inch) brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

### 3.1.4 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water riser shall have expansion loops or other provisions

such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer's Representative.

### 3.1.5 Commercial-Type Water Hammer Arrester

Commercial-type water hammer arrester shall be provided on hot- and cold-water supplies, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arrester, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arrester shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

### 3.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 862 kPa (125 psig) working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

### 3.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

#### 3.3.1 Threaded Joints

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

#### 3.3.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

#### 3.3.3 Union and Flanged

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm (2-1/2 inches) and smaller; flanges shall be used on pipe sizes 80 mm (3 inches) and larger.

#### 3.3.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

### 3.3.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiframe torch.

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA-02 with flux and are acceptable for line sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for lines 50 mm (2 inches) and smaller. Soldered joints shall conform to ASME B31.5 and CDA-02.

c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC-01 using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

### 3.3.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

### 3.4 Dissimilar Pipe Materials.

Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

### 3.5 Corrosion Protection for Buried Pipe and Fittings

#### 3.5.1 Cast Iron and Ductile Iron.

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA C105. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

#### 3.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

### 3.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

#### 3.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe shall extend a minimum of 100 mm (4 inches) above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm (1/4 inch) clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a suitable primer, backstop material and surface. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 15 mm (1/2 inch) from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

#### 3.6.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 4.9 kg per square meter (16 ounce) copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm (10 inches). For

cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm (8 inches) from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm (10 inches) in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

### 3.6.3 Waterproofing.

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm (1-1/2 inches) to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 40 mm; (1-1/2 inches;) then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 200 mm (8 inches) from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 40 mm (1-1/2 inches) to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

### 3.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 150 mm (6 inches) in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

### 3.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, a groove 6 to 13 mm (1/4 to 1/2 inch) wide by 6 to 10 mm (1/4 to 3/8 inch) deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a suitable sealant as specified above.

## 3.7 Supports

### 3.7.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring

hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

#### 3.7.1.1 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified Section 13082. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05500 MISCELLANEOUS METAL.

#### 3.7.1.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C (60 degrees F) or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
  - (1) Be used on insulated pipe less than 100 mm (4 inches).
  - (2) Be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C (60 degrees F) or less.
  - (3) Have a high density insert for pipe 50 mm (2 inches) and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 128 kg per cubic meter (8 pcf) or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm (1 foot) from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m (5 feet) apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 49 degrees C (120 degrees F) for PVC and 82 degrees C (180 degrees F) for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m (15 feet) nor more than 2 m (8

feet) from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 128 kg per cubic meter (8 pcf) or greater.

l. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used: (1) On pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C (60 degrees F) or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate. (2) On pipe less than 100 mm (4 inches) a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate. (3) On pipe 100 mm (4 inches) and larger carrying medium less than 15 degrees C (60 degrees F) a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm (4 inches) or by an amount adequate for the insulation, whichever is greater.

o. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

### 3.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

### 3.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm (4 inches) will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm (4 inches). Cleanout tee branches with screw

plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm (18 inches) of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron

### 3.10 WATER HEATERS AND HOT WATER STORAGE TANKS

#### 3.10.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping.

#### 3.10.2 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.12 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drainlines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

#### 3.12.1 Fixture Connections.

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

#### 3.12.2 Height of Fixture Rims Above Floor.

Lavatories shall be mounted with rim 775 mm (31 inches) above finished floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

### 3.12.3 Fixture Supports.

Fixture supports for lavatories and water closets shall be floor mount  
Backflow Prevention Devices.

3.12.3.1 Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC-01 at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

### 3.13 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

### 3.14 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm (2 inches) above the flood rim of the funnel to provide an acceptable air gap.

### 3.15 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311.

### 3.16 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, 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 setscrew.

### 3.17 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

### 3.18 TESTS FLUSHING AND STERILIZATION

### 3.18.1 Plumbing System

The plumbing system shall be tested in accordance with NAPHCC-01.

#### 3.18.1.1 Test of Backflow Prevention Assemblies.

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

#### 3.18.1.2 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to MPa (150 psig) and hold this pressure for 2 hours with no drop in pressure.

### 3.19 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be permitted.

### 3.20 System Flushing

After tests are completed, potable water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 0.762 meters per second (2.5 feet per second) through piping being flushed. Flushing shall be continued until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the work is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

### 3.21 Operational Test

Upon completion of and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet.

Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

### 3.22 Disinfection

After pressure tests have been made, the entire domestic hot- and cold-water distribution system shall be sterilized. System shall be thoroughly flushed with water of sufficient velocity until all entrained dirt and other foreign material 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 water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being sterilized shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing 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.

### 3.23 PLUMBING FIXTURE SCHEDULE

P-1 WATER CLOSET HANDICAPPED: Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor mounted. Floor flange shall be copper alloy, cast iron, or plastic. Gasket shall be wax type. Seat - CID A-A-238, Type A, white plastic, elongated, open front. Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) at the point where the diaphragm is sealed between the upper

and lower chambers. The maximum water use shall be 6 liters (1.6 gallons) per flush. Flush Tank - An adequate quantity of water shall be provided to flush and clean the fixture served. The water supply to flush tanks equipped for manual flushing shall be controlled by a float valve or other automatic device designed to refill the tank after each discharge, and to completely shut off the water flow to the tank when the tank is filled to operational capacity. Water closets having their flush valve seat located below the flood level rim of the closet bowl shall have a ballcock installed within a sheath or in a separate and isolated compartment of the tank, both to have visible discharge onto the floor in case of failure. Provision shall be made to automatically supply water to the fixture so as to refill the trap seal after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled by a suitable timing device. Ballcocks shall meet ASSE 1002. Flush Valve in Flush Tank - Flush valve seats in tanks for flushing water closets shall be at least 25 mm (1 inch) above the flood level rim of the bowl connected thereto, except in approved water closet and flush tank combinations designed so that when the tank is flushed and the fixture is clogged or partially clogged, the flush valve shall close tightly so that water will not spill continuously over the rim of the bowl or back flow from the bowl to the tank. Top rim of bowl shall be 457 mm (18 inches) above the floor.

P-2 LAVATORY: Manufacturer's standard sink depth, enameled cast iron ASME A112.19 shelf back type. Faucet - Faucets shall be center set, mixing type. Faucets shall have replaceable seats and washers. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. The flow shall be limited to 1.57 liters per second (2.5 gpm) at a flowing pressure of 549 kPa. (80 psi.) Handles -Crown type. Cast, formed, or drop forged copper alloy. Drain -Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. See paragraph FIXTURES for optional plastic accessories.

P-3 EMERGENCY SHOWER: Head for Emergency and Emergency Eye and Face Wash. Shower control shall be 1 inch or 1-1/2 inch stay-open type control valve. Unit shall be corrosion-resisting steel or enameled cast iron and shall be pedestal mounted as indicated.

P-4 LABORATORY SINK: acid-resistant plastic ANSI Z124. Thickness of sinks shall be manufacturer's standard. Drain and trap shall be stainless steel. Faucet and Spout - Cast or wrought copper alloy. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

P-5 SHOWER: Shower heads, CID A-A-240 other than emergency showers, shall include a non-removable, tamperproof device to limit water flow to 0.16 liters per second (2.5 gpm) when tested in accordance with ASME A112.18.1M. Wall Mounted: Shower head shall be stainless steel or chromium plated brass with ball joint. Handles shall be manufacturer's option. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be separate hot and cold water type. Shower head shall be vandalproof with integral back.

**TABLE I**  
**PIPE AND FITTING MATERIALS FOR**  
**DRAINAGE, WASTE, AND VENT PIPING SYSTEMS**

Item No.	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with	X	X	X	X	X	

	compression gaskets						
2	Cast iron pipe and fittings hubless, CISPI 301 and ASTM A 888	X	X	X	X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47	X	X		X	X	
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47 for use with Item 5	X	X		X	X	
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X	
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152 C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X				
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
10	Steel pipe, seamless galvanized, ASTM A 53, Type S, Grade B	X			X	X	
11	Seamless red brass pipe, ASTM B 43			X	X		
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
14	Seamless copper pipe, ASTM B 42						X
15	Cast bronze threaded fittings, ASME B16.15				X	X	
16	Copper drainage tube, (DWV), ASTM B 306	X†	X	X†	X	X	
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	X
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40)	X	X	X	X	X	X
21	Process glass pipe and fittings, ASTM C 1053						X
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518		X			X	
23	Polypropylene (PP) waste pipe and fittings, ASTM D 4101						X

24 Filament-wound reinforced thermosetting  
resin (RTRP) pipe, ASTM D 2996  
SERVICE:

X

- 
- A - Underground Building Soil, Waste and Storm Drain
  - B - not used
  - C - not used
  - D - Aboveground Vent
  - E - not used
  - F - not used
  - † - Hard Temper

**TABLE II**  
**PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS**

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
1	Malleable-iron threaded fittings,	X	X	X	X
a.	Galvanized, ASME B16.3 for use with Item 4a				
b.	Same as "a" but not galvanizedX for use with Item 4b				
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47, non-ferrous pipe, ASTM A 536 and ASTM A 47	X	X	X	
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47 for use with Item 2	X	X	X	
4	Steel pipe:	X	X	X	X
a.	Seamless, galvanized, ASTM A 53, Type S, Grade B				
b.	Seamless, black, X ASTM A 53, Type S, Grade B				
5	Seamless red brass pipe, ASTM B 43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Item 4	X	X		X
7	Seamless copper pipe, ASTM B 42	X	X		X
8	Seamless copper water tube, ASTM B 88	X††	X††	X††	X†††
9	Seamless and welded copper distribution tube (Type D) ASTM B 641	X††	X††	X††	X††††
10	Cast bronze threaded fittings, ASME B16.15 for use with Items 7 and 8	X	X		X
11	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 7 and 8	X	X	X	X
12	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 7 and 8	X	X	X	X
13	Bronze and sand castings grooved joint pressure fittings for non- ferrous pipe ASTM B 584, for use with Item 2	X	X	X	
14	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			X
15	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X			X
16	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239	X			X
17	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 12, 13, and 16	X			X
18	Socket-type polyethylene fittings for outside diameter-controlled	X			X

	polyethylene pipe, ASTM D 2683 for use with Item 13			
19	Polyethylene (PE) plastic tubing, ASTM D 2737	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846	X	X	X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441	X		X
22	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442	X		X
23	Threaded chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21	X	X	X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Item 23	X	X	X
25	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Item 23	X	X	X
26	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X		X
27	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X		X
28	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X		X
29	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467	X		X
30	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X		X
31	Joints for IPS pvs pipe using solvent cement, ASTM D 2672	X		X
32	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996	X	X	
33	Steel pipeline flanges, MSS SP-44	X	X	
34	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X	
35	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X
36	Malleable-iron threaded pipe unions ASME B16.39	X	X	
37	Nipples, pipe threaded ASTM A 733	X	X	X

A - Cold Water Aboveground B - Hot Water 82 degree C (80 degrees F) Maximum  
Aboveground C - Compressed Air Lubricated D - Cold Water Service Belowground  
Indicated types are minimum wall thicknesses. †† - Type L - Hard ††† - Type K  
- Hard temper with brazed joints only or type K-soft temper without joints in  
or under floors †††† - In or under slab floors only brazed joints

END OF SECTION

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## SECTION 15895

## AIR DISTRIBUTION 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.

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 350 (1986) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment

ARI 410 (1991) Forced-Circulation Air-Cooling and Air-Heating Coils

ARI 440 (1989) Room Fan-Coil Air-Conditioners

## AIR DIFFUSION COUNCIL (ADC)

ADC 1062:GRD (1984) Test Codes for Grilles, Registers and Diffusers

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210 (1985) Laboratory Methods of Testing Fans for Rating

AMCA 300 (1985; Rev 1987; Errata) Reverberant Room Method for Sound Testing of Fans

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1990b) 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 167 (1991) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 181 (1990) Forgings, Carbon Steel, for General-Purpose Piping

ASTM A 193 (1991a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 234 (1991c) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A 525 (1991b) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 62	(1990) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1992a) Seamless Copper Tube
ASTM B 88	(1992) Seamless Copper Water Tube
ASTM B 117	(1990) Salt Spray (Fog) Testing
ASTM C 107	(1989) Panel Spalling Testing High-Duty Fireclay Brick
ASTM C 1071	(1991) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 1654	(1979a; R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 3359	(1990) Measuring Adhesion by Tape Test
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)	
ASME-17	(1992; Addenda Dec 1992) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME B1.20.1	(1983) Pipe Threads, General Purpose (Inch)
ASME B16.5	(1992) Pipe Flanges and Flanged Fittings
ASME B16.9	(1986) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1986) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1992) Power Piping
AMERICAN WELDING SOCIETY (AWS)	
AWS D1.1	(1992) Structural Welding Code - Steel

## ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 9 (1990) Load Ratings and Fatigue Life for Ball Bearings

AFBMA 11 (1990) Load Ratings and Fatigue Life for Roller Bearings

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419 (Rev A) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types Replaceable)

## FEDERAL SPECIFICATIONS (FS)

FS WW-V-35 (Rev C) Valve, Ball

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1978; R 1988) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (1988) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1990) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends

MSS SP-80 (1987) Bronze Gate, Globe, Angle and Check Valves

MSS SP-85 (1985) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

## MILITARY SPECIFICATIONS (MS)

MS DOD-P-21035 (Rev A) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

MS MIL-A-3316 (Rev C; Am 2) Adhesives, Fire-Resistant, Thermal Insulation

MS MIL-E-17813 (Rev E) Expansion Joints, Pipe, Metallic Bellows

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1989) Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

SMACNA-05	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA-06	(1985) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-10	(1985) HVAC Air Duct Leakage Test Manual
UNDERWRITERS LABORATORIES (UL)	
UL 181	(1990; Rev Nov 1990) Factory-Made Air Ducts and Connectors
UL 555	(1990; Rev Jan 1990) Fire Dampers

## 1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

## 1.3 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

## 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:

### SD-01 Data

Components and Equipment Data; FIO.

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following: ductwork Components

### SD-04 Drawings

Air Supply and Distribution Equipment; GA.

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger detail, gauge reinforcement, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

### SD-06 Instructions

Test Procedures; FIO.

Proposed test procedures for ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

#### SD-07 Schedules

Test Schedules; FIO.

Proposed test schedules for ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

#### SD-09 Reports

Test Reports; FIO.

Test reports for the ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document all phases of tests performed including initial test summary, all repairs/adjustments made, and final test results.

#### SD-19 Operation and Maintenance Manuals

Air Supply and Distribution Manuals; GA.

Four manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, 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.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS.

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The equipment items shall be supported by a service organization.

### 2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

### 2.3 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

### 2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

## 2.5 NOT USED

## 2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be in accordance with Section ELECTRICAL WORK, INTERIOR. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be in accordance with NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided.

## 2.7 CONTROLS

Controls shall be provided as recommended by the manufacturer. Thermostat shall be wall mounted.

## 2.8 DUCTWORK COMPONENTS

2.8.1 Metal Ductwork. All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA-06 unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 125, 250, and 500 Pa (1/2, 1, and 2 inch w.g.) ductwork shall meet the requirements of Seal Class C. Class 750 through 2500 Pa (3 through 10 inch) shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA-06. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 50 mm (2 inch) band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable.

2.8.2 Metallic Flexible Duct. Metallic type duct shall be single-ply galvanized steel. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or negative working pressure of 343 degrees C (650 degrees F).

### 2.8.3 Not Used

### 2.8.4 Duct Sleeves, Framed Prepared Openings, Closure Collars

#### 2.8.4.1 Duct Sleeves.

All square, rectangular, and oval ducts passing through floors, walls, or ceilings shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared

openings shall be fabricated from 20-gauge galvanized steel, unless otherwise indicated.

2.8.4.2 Framed Prepared Openings. Openings shall have 1-inch clearance between the duct and the opening or 1-inch clearance between the insulation and the opening for insulated ducts.

2.8.4.3 Closure Collars. Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier.

2.9 NOT USED

2.10 NOT USED

2.11 AIR MOVING DEVICES

2.11.1 Room Fan-Coil Units. Base units shall include galvanized coil casing, coil assembly, drain pan, outside air damper, wall intake box, air filter, fans, motor, fan drive, and motor switch, plus an enclosure for cabinet models. Leveling devices integral with the unit shall be provided for vertical type units. Sound power levels shall be as indicated. Sound power level data or values for these units shall be obtained in accordance with test procedures based on ARI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models will be acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Automatic valves and controls shall be provided as specified in paragraph CONTROLS. Each unit shall be fastened securely to the building structure. Capacity of the units shall be as indicated. Room fan-coil units shall be certified as complying with ARI 440, and shall meet the requirements of UL 1995.

2.11.1.1 Enclosure. Enclosure shall be fabricated of not lighter than 18-gauge steel, reinforced and braced. Front panel of enclosure shall be removable and provided with 1/2-inch thick foil faced fibrous glass insulation in fan section and coil section. Return air grille shall be integrally stamped. Provide mixing boxes as indicated with manually adjustable outside air dampers. Ferrous metal surfaces shall be galvanized or factory finished with corrosion resistant enamel. Access door or removable panel shall be provided for control compartment. Duct discharge collar shall be provided for concealed models. Enclosures shall have easy access for filter replacement.

2.11.1.2 Fan. Fan shall be galvanized steel or aluminum, multiblade, centrifugal type. Fan shall not be fabricated of non-metallic materials. Fan shall be dynamically and statically balanced. Surfaces shall be smooth. Assemblies shall be accessible for maintenance. Disassembly and reassembly shall be by means of mechanical fastening devices and not by epoxies or cements.

2.11.1.3 Duct Package

Provide factory fabricated duct package for air distribution as indicated.

2.11.1.4 Drain Pan

Drain and drip pan shall be sized and located to collect all water condensed on and dripping from any item within the unit enclosure or casing. Drain pan shall be constructed of not lighter than 21-gauge steel, galvanized after fabrication, thermally insulated to prevent condensation. Insulation shall have a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and be of a waterproof type or coated with a waterproofing material. In lieu of the above, drain pan may be constructed of die-formed 22-gauge steel, formed from a single sheet, galvanized after fabrication, insulated and coated as specified for the 21-gauge material or of die-formed 21-gauge type 304 stainless steel, insulated as specified above. Drain pan shall be pitched to drain. Minimum 3/4-inch NPT or 5/8-inch OD drain connection shall be provided in drain pan.

2.11.1.5 Manually Operated Outside Air Damper. Manually operated outside air damper shall be provided in accordance with the arrangement indicated. Damper shall be parallel airfoil type and of galvanized construction. Blades shall rotate on stainless steel or nylon sleeve bearings.

2.11.1.6 Filters. Filters shall be of the fiberglass disposable type, manufacturer's standard thickness, conforming to CID A-A-1419. Filters in each unit shall be removable without the use of tools.

2.11.1.7 Motor. Motor shall be of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fan.

2.11.2 Ceiling Exhaust Fan. Suspended cabinet-type ceiling exhaust fan shall be centrifugal type, direct-driven. Fan shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motor shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fan shall be U.L. listed.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations.

3.1.9 Equipment and Installation. Frames and supports shall be provided for fans, dampers, and other similar items requiring supports.

#### 3.1.12 Sleeved and Framed Openings

Space between the sleeved and the duct or the duct insulation shall be packed for fire rated penetrations. For nonfire rated penetrations, the space shall be caulked.

#### 3.1.13 Metal Ductwork

Installation shall be in accordance with SMACNA-06. Duct supports for sheet metal ductwork shall be in accordance with SMACNA-06. Friction beam clamps indicated in SMACNA-06 will not be used. Where C-clamps are used, retainer clips shall be provided.

#### 3.1.15 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be in accordance with Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.2 FIELD PAINTING AND PIPING IDENTIFICATION

Finish painting of items only primed at the factory or surfaces not specifically noted otherwise and identification for piping shall be painted and/or identified.

### 3.5 CLEANING AND ADJUSTING

Inside of room fan-coil units, ducts, and casing shall be thoroughly cleaned of all debris and blown free of all small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Miscellaneous equipment requiring adjustment shall be adjusted to setting directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

### 3.7 PERFORMANCE TESTS

Each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 1/4 day for the entire ventilation system and shall demonstrate that the entire system is functioning in accordance with the specifications.

### 3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 1 hr of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

END OF SECTION



THIS SECTION DELETED IN IT'S ENTIRETY BY R0005

~~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.~~

~~NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)~~

~~NFPA 70 (1990) National Electric Code~~

~~UNDERWRITERS LABORATORIES (UL)~~

~~UL 478 (1986) Information Processing and Business Equipment~~

~~UL 508 (1990) Industrial Control Equipment~~

~~1.2 GENERAL REQUIREMENTS~~

~~1.2.1 The Contractor shall provide all services, materials, and equipment necessary to monitor all parameters specified and to control al indicated pump and fan motors. Services shall include complete design, installation, and testing. The system shall be a programmable logic controller (PLC) based system with a personal computer (PC), a PC data management system (DMS), monitors, keyboards, ink jet printer, appropriate interface cards, sensors, and signal conditioners. The design shall include all wiring and conduit between sensors and PLC's, an instrumentation console, and a master control panel. The system shall be suitable for communications over voice grade telephone cables. Data monitoring and control software shall be provided. PLC and DMS shall be located in the Control Building.~~

~~1.2.1.1 The designer shall have recent experience in the design, system integration, and installation of water plant related instrumentation and control systems.~~

~~1.2.2 Environmental Conditions~~

~~All equipment shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered at the typically industrial locations.~~

~~1.2.3 Standard Products~~

~~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. 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 controls shall provide the required sequence of operation. No pneumatics will be allowed for control logic.~~

#### ~~1.2.4 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.~~

#### ~~1.2.5 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.~~

#### ~~1.2.6 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.~~

### ~~1.3 SUBMITTALS~~

~~Government approval is required for submittals with a "CA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:~~

#### ~~Data~~

##### ~~Training Data; CA.~~

~~Training Course: The supplier shall submit a training course in the maintenance and operation of the systems, approved 30 days prior to the start of training and with training complete 10 days prior to the Performance Verification/Acceptance test. The training course shall be conducted for a number of operating staff members, total number of personnel to be designated by the Contracting Officer, in the maintenance and operation of the systems including specified hardware and software. A training day is defined as 8 hours of classroom instruction, including breaks and lunche time, Monday through Friday, during the daytime shift in effect at the training facility. The course shall be taught at the project site for no fewer than 2 days. No training shall be scheduled until training manuals and draft O&M manuals have been approved by the Government.~~

##### ~~Preliminary Data; CA~~

~~The system supplier shall submit preliminary equipment data in booklet form, indexed to the to the specification paragraphs and shall consist of data sheets that document compliance with the specification. The preliminary data shall provide sufficient information for the installation of the system including descriptions, sequence of operation to show how the equipment will operate to meet the specified performance, and provide capabilities for future expansion.~~

~~a. Drawings~~

~~The incorporation of as built control information shall be provided. The drawings shall include a drawing index, list of symbols, each component location with unique identifier, each control system including block diagrams, wiring diagrams, and sequence of operation. The sequence of operation for each 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 wiring diagram shall show the interconnection of wires and cables from the identified terminals of starters and packaged equipment, input/output devices to DDC controller terminal blocks, to the building's primary controller/maintenance terminal, to the remote EMS equipment in Building 555, including all necessary jumpers and ground connections. The wiring diagram shall show the labels of all conductors. All sources of power required for control systems and for packaged equipment control systems shall be identified back to the panelboard circuit breaker number, system component, 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.~~

~~Statements~~

~~Performance Verification Testing and Acceptance Testing; FIO.~~

~~Three (3) copies of the Performance Verification/Acceptance Test procedures shall be due 15 days prior to Performance Verification/Acceptance Test. Using Commissioning Procedures previously approved, physical and functional requirements of the project, including devices, controller's, computer's, communication's hardware and software, compliance of the installed system with the contract documents shall be demonstrated. The performance verification/acceptance test procedures shall explain, step by step, the actions and expected results that will demonstrate that the systems perform in accordance with the sequences of operation from field devices to central monitoring stations. The performance verification/acceptance test shall not be started until after receipt of written permission by the Government, based on the approved Commissioning Procedures, delivery of the Draft M&O Manuals, Completion of the Training Course by Government Personnel, and the Contractor's written certification of successful completion of site testing and training. The three (3) copies of the Performance Verification/Acceptance Test are to be routed to the Contracting Officer.~~

~~Commissioning Procedures; FIO.~~

~~The system supplier shall develop and submit Commissioning Procedures for the system 35 days prior to the Performance Verification/Acceptance Test. The Commissioning Procedures shall be in accordance with specification section 15995, "Commissioning of Vehicle Wash Systems," and shall demonstrate commissioning procedures for each control system, for each type of terminal unit control system, and in coordination with other aspects and systems within the facility. 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.~~

~~System's Calibration, Adjustments, and Commissioning~~

~~Personnel, equipment, instrumentation, and supplies shall be provided by the Contractor as necessary to perform site testing, adjusting, calibration and commissioning. Wiring shall be tested for continuity and for ground, open, and~~

~~short circuits. Written Government approval of the specific testing procedures documentation and coordination, as noted, shall be obtained prior to the Performance Verification/Acceptance Test. Commissioning shall be in accordance with Specification Section 15995, "Commissioning of Vehicle Wash Systems," and shall demonstrate commissioning procedures for each control system, for each type of terminal unit control system, and in coordination with other aspects and related systems within/without the facility. 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. Communications requirements shall be as indicated.~~

~~—Reports~~

~~Test Reports; FIO.~~

~~Six copies of the site testing data. Original copies of all data produced during site testing, including results of each test procedure, after approval of the site tests.~~

~~Performance Verification and Acceptance Report; FIO.~~

~~Six copies of the performance verification and acceptance test report after completion of a successful test.~~

~~Documentation of test results for the entire control system complete, in booklet form and indexed, within 30 days after each test.~~

~~Operation and Maintenance Manuals~~

~~Operation and Maintenance Manuals; CA.~~

~~The Technical Data Package consisting of the operation, maintenance data (including As Built Drawings), and software application shall be in manual format. The final copies of the O&M manuals shall be provided within 30 days after completing the Performance Verification/Acceptance Test.~~

~~Three (3) copies of the final manuals shall be provided in hard copy. The final hard copies shall include a table of contents and tab sheets (with tab sheets placed at the beginning of each chapter or section and at the beginning of each appendix), bound in hardback, and placed in loose leaf binders. 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.~~

~~One (1) copy of the final Operation and Maintenance Manual shall be placed on CD ROM. Text shall be in Microsoft Word. Drawings shall be Computer Aided Design/Drafting (CADD) in AutoCAD for Windows and on a single 5-1/4" compact disk (CD). All disks are to be factory formatted ANSI/ISO for use in ISO CCS standard systems. Each disk shall be provided a label which indicates the Building Number, the Project Number (PQWY), and the date created. The Contractor shall be available to answer questions concerning interpretation of the database and related matters of this nature.~~

~~Software Manual; CA.~~

~~The software manual shall be segmented with tab sheets placed at the beginning of each level of computer application in the system. The manual shall describe the functions of all software, and shall include all other~~

~~information necessary to enable proper loading, testing and operation. Manual shall include, but not be 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; CA.~~

~~The Operation Manuals shall include for each control system, step by step procedures required for each system's startup, operation, and shutdown. The manuals shall include all detail drawings, equipment data, and manufacturer supplied operation manuals for all equipment. Should include, but not limited to, the following:~~

- ~~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.~~

~~Maintenance Manual and As Built Drawings; CA.~~

~~The maintenance manuals shall include a maintenance check list for each 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, maintenance and software manuals are provided in a common volume, they shall be clearly differentiated and separately indexed. Included in the Maintenance Manuals shall be the as built drawings.~~

## ~~1.5 MAINTENANCE AND SERVICE~~

### ~~1.5.1 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.~~

### ~~1.5.2 Description of Work~~

~~The adjustment and repair of the system shall include the manufacturer's required adjustments of computer equipment, software updates, and instrumentation and control devices.~~

### ~~1.5.3 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.~~

### ~~1.5.4 Scheduled Inspections~~

~~Two inspections shall be performed at 6 month intervals and all work required shall be performed and coordinated with Government Maintenance Personnel. Inspections shall be scheduled in March/April/May and September/October/November time frames to establish commissioning verification of system operation during seasonal changes effecting the systems. Coordination with and assistance from Government Maintenance Personnel will be required during inspections. These inspections shall include:~~

~~a. Visual checks and operational tests of all equipment.~~

~~b. 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.~~

~~c. Run all system software diagnostics and correct any diagnosed problems.~~

### ~~1.5.5 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.~~

### ~~1.5.6 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.~~

## ~~PART 2 PRODUCTS~~

### ~~2.1 GENERAL EQUIPMENT REQUIREMENTS~~

#### ~~2.1.1 Electrical and Electronic Devices~~

~~Electrical and electronic devices not located within a control panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown. DDC controllers shall be mounted in NEMA, ventilated, type 2 enclosures equipped with a hinged cover for easy access. Enclosures shall be sized to provide sufficient maintenance access to installed equipment.~~

#### ~~2.1.2 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.~~

##### ~~2.1.2.1 Pressure~~

~~Pressure with a range for the specific application plus or minus 2.0 percent of range (display and print to nearest psi).~~

##### ~~2.1.2.2 Flow~~

~~Flow with a range for the specific application plus or minus 3.0 percent of range (display and print to nearest unit, such as gallons per minute).~~

#### ~~2.1.3 Year 2000 Compliance~~

~~All microprocessor based equipment and software shall be Year 2000 compliant.~~

### ~~2.2 INSTRUMENTATION AND CONTROL (I&C) DIAGRAMS~~

~~Framed mylar drawings in laminated plastic shall be provided. Drawings shall show complete I&C diagrams for all equipment furnished and interfaces to all existing equipment, at each respective equipment location. Condensed operating instructions explaining preventative maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system manually shall be prepared in typed form, framed as specified for the I&C diagrams and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting. The instructions shall be posted after completion of the Contractor's site testing. A mylar reproducible of each diagram shall be provided in addition to the posted copy.~~

### ~~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.~~

## ~~2.4 INSTRUMENTATION and control system equipment~~

### ~~2.4.1 General~~

~~Central monitoring equipment shall be sized to monitor data from all existing wells and shall be expandable. Specific monitoring points shall be as indicated on the chart at the end of this section. The central monitoring equipment shall, as a minimum, consist of the following major subsystems and a master control panel: 1. Central processing unit (CPU) for process control, 2. Data Management System (DMS) for gathering and reporting historical data.~~

### ~~2.4.2 Central Processing Unit (CPU)~~

~~The CPU shall be a medium size PLC with a minimum of 96K of user configurable memory 64 PID loops, and RLL special function programming.~~

#### ~~2.4.2.1 Input/Out put (I/O) Modules~~

~~The I/O shall be 24VDC for digital and 4/20mADC for analog signals. Additional modules shall be provided as required.~~

### ~~2.4.3 Data Management System (DMS)~~

~~The DMS shall be a 486 compatible computer with the following minimum configuration 16 MB RAM, 2 GB hard disk, 8X CD ROM drive, one 3.5 inch floppy drive, super VGA graphics adapter, 2 RS232 ports, 101 key standard keyboard, current operating system software, 32bis modem, ink jet printer, 16 inch minimum color monitor, operator's custom keyboard (industrial membrane type), associated communications modules, development and applications software.~~

### ~~2.4.4 Master Control Panel~~

~~The master control panel shall be custom designed to house the controls, lights, switches, power supplies, etc. The panel shall be designed to provide direct manual control and status indication of pump and fan motors and of electrically operated valves. Manual control from the master control panel shall function independently from the PLS and CVU subsystems.~~

## ~~2.5 INSTRUMENTATION AND CONTROL SYSTEM SENSORS~~

### ~~2.5.1 General~~

~~Performances of functions or parameters are described individually. Multiple functions or parameters may be derived from a a signle sensor, e.g. phase loss and phase reversal are often monitored by a common device. Accumulation functions amy be software generated, e.g. motor running time maay be determined by the PC's clock in lieu of providing a dseparate dedicated device for each motor. Functions or parameter savailable on mechanical systems may be used only if the data acquisition does no interfere iwth the associated mechancial ssystem. Provide appropriate sensors where required.~~

### ~~2.5.2 Power Phase Loss~~

~~Provide phase monitoring and warning indication and motor shutdown on loss of phase on site power. Provdi creason for motor shutdown at insturmentation console.~~

### ~~2.5.3 Power Phase Reversal~~

~~Provide phas e monitoring and warning indication and motor shutdown on detection of phase reversal on site power. Provide reason for motor shutdown at instrumentation console.~~

### ~~2.5.4 Motor Running Time~~

~~Provide accumulation of motor running time for each water pump motor. Provide indication of motor on or off status as indicated.~~

### ~~2.5.5 Pump Motor Control~~

~~Provide capability to start ofr stop water pump motor from the instrumentation console.~~

#### ~~2.5.6 Smoke Detection~~

~~Provide single zone fire detection and control panel in the pump houses with smoke detectors and exterior horns. Smoke detector status and alarm shall be monitored at the instrumentation console.~~

#### ~~2.5.7 Low Temperature Sensor~~

~~Provide analog value of water temperature at each flooded well. Provide warning when water temperature falls below a preset value.~~

#### ~~2.5.8 Level Indicator~~

~~Provide means to detect when water level falls to within 1 meter (3 feet) of well pump intakes and to shut down pump motors on that condition. Provide reason for motor shutdown at instrumentation console.~~

#### ~~2.5.9 Basin Water Level~~

~~Provide analog value of water level at each water basin (settling pond). Calibrate to indicate 0-100% full scale.~~

#### ~~2.5.10 Flow Meter/Totalizer~~

~~Provide analog value of water flow for each water pump. Provide for total flow over any given time period.~~

#### ~~2.5.11 Water Detector, Air Purge Discharge~~

~~Provide indication of water flow in air purge discharge lines.~~

#### ~~2.5.12 Water Detector, Basin Overflow~~

~~Provide indication of water flow in basin overflow lines.~~

### ~~2.6 INSTRUMENTATION AND CONTROL SYSTEM SOFTWARE~~

### ~~2.6.1 General~~

~~The software shall be provided in three distinct systems. The software for the PLC shall provide the interface to all sensor data and control functions. The software for the DMS shall extract operational data and provide current and historical data automatically and upon demand. All software shall be provided with a user license for the machine in which it is installed. Software for each PLC, and DMS shall consist of the hardware manufacturer's programming software and the applications software written by the instrumentation and control system designer and supplier. All software shall be fully documented, tested, and supported. Each system shall be programmed for automatic startup after power failure.~~

### ~~2.6.2 PLC Software~~

~~The PLC software shall be written to monitor and control parameters as indicated in the chart at the end of this section. The software shall allow for stand alone operation at each site.~~

### ~~2.6.3 DMS Software~~

~~The DMS shall use a Unix operating system for a full multi tasking and multi-user operating environment. A DOS operating system will not be acceptable. The system shall provide unattended operation with automatic backup every 24 hours. The system shall extract data from PLC's, organize data for current, hourly, daily and monthly reports, track minimums, maximums, and averages of analog data, and indicate status of all operating units and alarm points. Report generation shall be menu driven.~~

## ~~2.7 PRESSURE SWITCHES AND SOLENOID VALVES~~

### ~~2.7.1 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.~~

### ~~2.7.2 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.~~

## ~~2.8 INDICATING DEVICES~~

### ~~2.8.1 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.~~

## ~~2.9 RELAYS~~

### ~~2.9.1 Control 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.~~

#### ~~2.9.2 Current Sensing Relays~~

~~Current sensing relays shall be of a design that provides a normally open (NO) single pole, single throw (SPST) contact rated at a minimum of 50 volts peak and one half amp or 25 VA, noninductive. Current sensing relays shall be single unit construction with provisions for firm mounting. They shall have a single hole for passage of current carrying conductors and sized for operation at a nominal 50 percent of current rating of sensed device. The Contractor shall use multiple turns of sensed leads for higher rated loads, voltage isolation shall be for a minimum of 600 volts.~~

#### ~~2.10 UTILITY METERS~~

##### ~~2.10.1 Electrical Watthour Meters~~

~~Watthour meters shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR.~~

##### ~~2.10.2 Water Meters~~

~~Water meters shall be as specified in Section 15400 PLUMBING, GENERAL PURPOSE and shall be connected for remote monitoring through the Energy Management Central Station.~~

#### ~~2.11 WIRE AND CABLE~~

##### ~~2.11.1 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 ehloride (PVC).~~

##### ~~2.11.2 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.~~

##### ~~2.11.3 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.~~

##### ~~2.11.4 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 Control System~~

~~The 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 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~~

~~Initial system programming shall be performed by the Contractor or supplier according to system design documents. All configuration and programming equipment, required for program initialization, operation, modification, and troubleshooting, shall be provided with the system.~~

### ~~3.2 CONTROL SYSTEM INSTALLATION~~

~~All monitoring and control components shall be installed at the locations indicated and in accordance with the manufacturer's recommendations. The installation shall comply with all applicable requirements of the National Electrical Code.~~

#### ~~3.2.1 Indication Devices Installed in Piping~~

~~Gauges in piping systems subject to pulsation shall have snubbers.~~

#### ~~3.2.3 Device Mounting Criteria~~

~~Devices mounted in or on piping, on building surfaces, or in mechanical/electrical spaces, 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.~~

#### ~~3.2.4 Wiring Criteria~~

~~Wiring shall be installed without splices between control devices and 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 16415 ELECTRICAL WORK, INTERIOR. Other electrical work shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR and as shown.~~

### ~~3.3 TRAINING~~

~~The Contractor shall provide 24 hours of training for 15 user personnel in the programming, including software modifications, operation, and maintenance of the instrumentation and control system. Half of the training may be provided either at the project site or at an approved training facility, subject to the approval of the Contracting Officer. Half of the training shall be provided at the project site.~~

### ~~3.4 TESTING~~

~~After the installation is complete, the Contractor shall conduct functional and operational tests of the instrumentation and control system in accordance with the approved test procedure documents. Equipment shall be demonstrated to operate in accordance with the requirements herein. Tests shall be performed in the presence of the Contracting Officer. If deficiencies are found, corrections shall be made and the system retested to assure that it is properly functional.~~

Instrumentation Matrix

	<del>Sand Filter Charge Pumps (P- 1A, P-1B)</del>	<del>Basin Flush/ Fill Pumps (P-3A, P- 3B)</del>	<del>Water Cannon Pumps (P-4A, 4B, 4C)</del>	<del>Sump Pumps</del>
<del>Power Phase Loss</del>	<del>*</del>	<del>*</del>	<del>*</del>	
<del>Power Phase Reversal</del>	<del>*</del>	<del>*</del>	<del>*</del>	
<del>Kilowatt Hours</del>	<del>*</del>	<del>*</del>	<del>*</del>	<del>*</del>
<del>Motor Running Time</del>	<del>*</del>	<del>*</del>	<del>*</del>	<del>*</del>
<del>Pump Motor Control (Remote Start/Stop)</del>	<del>*</del>	<del>*</del>	<del>*</del>	
<del>Motorized Valve Control (Remote Open/Close)</del>	<del>*</del>	<del>*</del>	<del>*</del>	
<del>Smoke Detection System</del>		<del>*</del>	<del>*</del>	
<del>Low Temperature Sensor</del>		<del>*</del>	<del>*</del>	
<del>Well Water Level Indicator</del>		<del>*</del>	<del>*</del>	
<del>Water Basin Level Indicator</del>		<del>*</del>	<del>*</del>	
<del>Flow Meter/Totalizer</del>	<del>*</del>	<del>*</del>	<del>*</del>	
<del>Water Detector, Air Purge</del>	<del>*</del>	<del>*</del>	<del>*</del>	
<del>Water Basin Overflow</del>	<del>*</del>			

~~END OF SECTION~~

## SECTION 16375

## ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

## 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 RR-F-621 (Rev E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1997) National Electrical Safety Code

ANSI C12.1 (1988) Code for Electricity Metering

ANSI C12.4 (1984; R 1990) Mechanical Demand Registers

ANSI C12.10 (1987) Electromechanical Watthour Meters

ANSI C12.11 (1987) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

ANSI C29.1 (1988) Electrical Power Insulators - Test Methods

ANSI C57.12.13 (1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations

ANSI C57.12.22 (1989) Transformers - Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High-Voltage, 34 500 GrdY/19 920 Volts and Below; Low Voltage, 480 Volts and Below

ANSI C57.12.27 (1982) Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations

ANSI C80.1 (1990) Rigid Steel Conduit - Zinc Coated

ANSI C119.1 (1986) Sealed Insulated Underground Connector Systems Rated 600 Volts

ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

ANSI O5.1 (1992) Specifications and Dimensions for Wood Poles

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48 (1983; R 1990) Gray Iron Castings

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 B 8 (1990) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM C 478 (1990b) Precast Reinforced Concrete Manhole Sections

ASTM D 923 (1991) Sampling Electrical Insulating Liquids

ASTM D 4059 (1991) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

ASTM F 883 (1990) Padlocks

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5 (1987) Thermoplastic and Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 35 kV

AEIC CS6 (1987; Rev Mar 1989) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 (1992; Supple I, II, and III) Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS HH-I-595 (Rev C) Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

FS W-F-1814/GEN (Rev A; Supple 1, Notice 1) Fuses, Cartridge, High-Interrupting Capacity

FS W-S-610 (Rev E) Splice Connectors

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE C37.41 (1988; 37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories

IEEE C57.12.00 (1987) Liquid-Immersed Distribution, Power, and Regulating Transformers

IEEE C57.13 (1978; R 1986) Instrument Transformers

IEEE C57.98 (1986) Guide for Transformer Impulse Tests - Appendix to C57.12.90

IEEE C62.1 (1989) Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits

IEEE C62.2 (1987) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems

IEEE C62.11 (1987) Metal-Oxide Surge Arresters for AC Power Circuits

IEEE Std 48 (1990) Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations

IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

IEEE Std 100 (1988) IEEE Standard Dictionary of Electrical and Electronics Terms

IEEE Std 386 (1985; R 1991) Separable Insulated Connector Systems for Power Distribution Systems Above 600V

IEEE Std 404 (1986) 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 High Voltage Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 (1986; Rev 1) Molded Case Circuit Breakers and Molded Case Switches

NEMA FB 1 (1988) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies

NEMA LA 1 (1986) Surge Arresters

NEMA PB1 (1990; PB 1.1) Panelboards

NEMA PB 2 (1989; PB 2.1) Deadfront Distribution Switchboards

NEMA SG 2 (1986) High-Voltage Fuses

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 (1988) Cross-Linked-Thermosetting - Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NEMA WC 8 (1988) 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 6 (1981; Rev thru Dec 1992) Rigid Metal Conduit

UL 198E (1988; Rev Jul 1988) Class R Fuses

UL 467 (1984; Rev thru Nov 1986) Grounding and Bonding Equipment

UL 486A (1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486B (1991; Rev thru Apr 1992) Wire Connectors for Use with Aluminum Conductors

- UL 489 (1991; Rev thru May 1992) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
- UL 514A (1991) Metallic Outlet Boxes
- UL 543 (1982) Impregnated-Fiber Electrical Conduit
- UL 651 (1989; Rev thru Dec 1989) Schedule 40 and 80 Rigid PVC Conduit
- UL 854 (1991; Rev Dec 1992) Service-Entrance Cables
- UL 1242 (1983; Rev thru Jan 1993) Intermediate Metal 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 625 m (1800 feet)
- b. Ambient Temperature 80 degrees F
- c. Frequency 60
- d. Seismic Zone 3

## 1.3 SUBMITTALS

Governmental 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 SUBMITTALS:

### Data

Manufacturer's Catalog Data; **FIO**.

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; **FIO**.

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; **FIO**.

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; **FIO**.

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; **FIO**.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings as well as all 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 all 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 submit 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 ten calendar days from the time the drawings are returned to the Contractor.

## Reports

Factory Test; **FIO**.

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 specified in applicable publications or in these specifications. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included. Field Testing; GA. A proposed field test plan, 20 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; GA. Six copies of the information described below in 216 by 279 mm binders having a minimum of 5 rings from which material may readily be moved and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of all equipment used, with calibration certifications.
- b. A copy of all 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 all adjustments made.

## Cable Installation Reports; GA.

Six copies of the information described below in 216 by 279 mm binders having a minimum of 5 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 all cable pulls numerically identified.
- b. A list of all equipment used, with calibration certifications. The manufacturer of 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; **FIO**.

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 under this section of the specifications 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; **FIO**.

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; **FIO**.

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; **GA**.

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, within 30 calendar days following the approval of 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).

#### 1.7 SEISMIC PROTECTION

Equipment, materials, and installation shall be in accordance with Section: SEISMIC PROTECTION FOR MECHANICAL AND ELECTRICAL EQUIPMENT (ZONE 2B).

## 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

Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of liters (gallons) and composition of liquid-dielectric, and shall be permanently marked with a statement that the dielectric 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 1 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 1 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 luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes. 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.

Cables shall be single conductor type unless otherwise indicated.

#### 2.4.1 Underground cables shall be soft drawn copper.

### 2.4.2 Medium-Voltage Cables

#### 2.4.2.1 General

Medium voltage cables shall conform to the requirements of NEMA WC 8 for cables utilizing ethylene-propylene-rubber (EPR) insulation. Cables shall be in accordance with the requirements of NFPA 70. Single conductor cables shall be provided except as otherwise indicated. Cables shall be manufactured within 12 months of purchase.

#### 2.4.2.2 Insulation

Cables shall utilize †ethylene-propylene-rubber (EPR) insulation. Cables shall be provided with 133 percent insulation level.

#### 2.4.2.3 Jackets

Cables shall be provided with a nonmetallic jacket

#### 2.4.2.4 Neutrals

Neutral conductors of grounded neutral systems except for concentric neutral cables shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable. Cables shall have 1/3 concentric neutral with an insulating jacket over the concentric neutral.

#### 2.4.2.5 Ratings

Medium-voltage cables shall be rated for a circuit voltage of 15 kV.

#### 2.4.3 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70. Cables shall utilize cross-linked thermosetting polyethylene (XLP) insulation and shall conform to the requirements of NEMA WC 7+ for ethylene-propylene-rubber (EPR) insulation and shall conform to the requirements of NEMA WC 8.

##### 2.4.3.1 In Duct

Cables shall be single-conductor cable, Type RHW, THW, THWN, TW, USE, or XHHW 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. All joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

#### 2.5.2 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of FS W-S-610 and conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, Type II, Class 2 of FS W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

#### 2.5.3 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. 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, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type, of suitable construction for the application and the type of cable connected, and include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points shall be provided.

#### 2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

##### 2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

2.5.4.2 Taped Terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 51 mm long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

#### 2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type. Where concrete encasement is not required, low-voltage circuits may utilize factory-installed cable in coilable plastic duct. Inner ducts shall be provided where indicated.

##### 2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

##### 2.6.2 Nonmetallic Ducts

###### 2.6.2.1 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

### 2.6.2.2 Direct Burial

UL 651 Schedule 40 and Schedule 80 as indicated, or NEMA TC 6 Type DB.

### 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 35 degrees F, shall neither slump at a temperature of 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, handholes, and pullboxes shall be as indicated. 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. In paved areas, frames and covers in vehicular traffic areas shall be rated for wheel loads in accordance with FS RR-F-621. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed lots, sidewalks, and turfed areas shall be from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in, sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

## 2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

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.

### 2.8.1 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.22 and shall be of the loop feed 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 C57.12.22. Pentahead locking bolts shall be provided with provisions for a padlock.

#### 2.8.1.1 High-Voltage Compartments

High-voltage compartments shall be dead-front construction. Primary protection shall include loadbreak switching, drawout dry-well-mounted current-limiting fuses, and medium-voltage separable connectors, and surge arresters. Switches shall be of the group-operated type. Switches may be mounted inside transformer tanks with switch operating handles located in high-voltage compartments and equipped with metal loops for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OFF" 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 OFF." Adjacent to switches, nameplates shall identify switch operating handles and "ON" and "OFF" positions. Surge arresters shall be fully insulated and configured to terminate on the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert.

#### 2.8.1.2 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.22 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 stencilled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity	<u>225</u> <del>150</del> kVA
Impedence	5.75%
Temperature rise	65 degrees C
High-voltage winding	<u>12470</u> <del>13800</del> volts
Low-voltage winding	480Y/277 volts

#### 2.8.1.3 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.

#### 2.8.1.4 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with ANSI 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.

#### 2.8.1.5 Efficiency

Transformers shall be of an energy efficient design. Efficiency of 225 KVA transformer shall be not less than 99.34 % of 50% loading. , with maximum losses and impedance, and minimum regulation, in accordance with Table I. No load losses

~~shall be at 100 percent rated voltage and frequency. Load losses and impedance shall be at 100 percent rated capacity. Contractor shall submit purchase cost and manufacturers calculations verifying Table I efficiencies before ordering transformers. Losses shall be guaranteed.~~

Table I — Transformer Efficiency

kVA	Phase	No Load	Load
		Losses (Watts)	Losses (Watts)
150	3	110	1230

#### 2.8.1.5.1 ~~Exceeding Guaranteed Losses~~

~~In the event that transformer test results indicate failure to meet Table I efficiencies, the government reserves the right to reject the transformers; or, to deduct from the contract amount the excess amount of the total owning cost. The total owning cost shall be defined as the total cost of losses plus purchase cost. No load losses shall be calculated at \$4,700 per kW and load losses at \$1,900 per kW. The excess amount of the total owning cost shall be the difference between guaranteed and test results. No adjustment to the contract price will be made if test results are less than guaranteed losses.~~

## 2.9 METERING AND PROTECTIVE DEVICES

### 2.9.1 Circuit Breakers, Low-Voltage

Low-voltage circuit breakers shall comply with NEMA SG 3 for power, and NEMA AB 1 and UL 489 for molded-case.

### 2.9.2 Fuses, Medium-Voltage, Including Current-Limiting

Medium-voltage fuses, including current-limiting, shall comply with NEMA SG 2.

### 2.9.3 Fuses, Low-Voltage, Current-Limiting

Low-voltage, current-limiting fuses shall comply with FS W-F-1814/GEN for Class L or UL 198E for Class R.

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 distribution class, rated as shown. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the combination valve-metal-oxide varistor type.

### 2.9.4 Watt Hour/Demand Meter

Demand watthour/demand meters shall meet ANSI C12.1 and C12.16. Outdoor meters shall be rated for, or placed in a NEMA Class 3 or 3R enclosure. Meters shall comply with the following:

#### 2.9.4.1 Watthour/Demand Meter Digital Readout

Meter shall have digital readout, and be capable of remote readout (with a computer which is NOT a part of this contract). Whole number multipliers are acceptable.

#### 2.9.4.2 Watthour/Demand Meter Monitoring Devices

Meter shall monitor all current in all three phases and the potential between all three phases.

#### 2.9.4.3 Watthour/Demand Meter Mounting

Meter shall be mounted on the entrance transformer in such a manner that the readout is easily read, access to the meter is available, and access to the

transformer is not impeded. Contractor is responsible for supplying all necessary fasteners to mount meter in a workmanlike manner.

2.9.4.4 Watthour/Demand meter Reset Function.

Meter shall be capable of being reset by only by operating a switch or button inside the meter enclosure. Demand meter shall read the largest amount of average power (W or kW) used in a 15 minute interval. Demand meter shall display the highest 15 minute average power level monitored, unless meter is reset. Watthours shall be cumulative unless reset.

2.9.4.5 Watthour/Demand Meter Tamperproofing Device

METER SHALL INCLUDE A LOCKING HASP OR SOME OTHER TAMPERPROOF LOCKING DEVICE. CONTRACTOR SHALL PROVIDE A SIMPLE, KEYED, NON-RUSTING PADLOCK FOR EACH METER. ALL PADLOCKS PROVIDED FOR EACH METER SHALL BE OPERATED FROM THE SAME KEY. MINIMUM OF TWO KEYS SHALL BE TURNED OVER TO THE CONTRACTING OFFICER. CONTRACTOR SHALL LOCK METER AFTER ALL INTERNAL SETTINGS ARE IN PLACE.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 19 mm in diameter by 3048 mm in length. Sectional type rods may be used.

2.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same

material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

#### 2.12 CONCRETE AND REINFORCEMENT

Concrete shall be a minimum of 2,500 psi at 28 days. All other requirements shall be as specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

#### 2.13 PADLOCKS

Padlocks shall conform to ASTM F 883, Type EPC, size 2.

#### 2.14 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.

##### 2.14.1 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. Coatings shall be seismically qualified in accordance with IEEE Std 344.

##### 2.14.2 Fireproofing Tape

Fireproofing tape shall be at least 51 mm wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

##### 2.14.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10-mil thick, conforming to FS HH-I-595.

#### 2.15 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 1 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

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 and other tests in accordance with IEEE C57.12.00.
- b. Factory Performed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.
- c. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.
- d. Transformer Efficiency. Tests shall be performed in accordance with paragraph: Efficiency.

#### 2.17 General Lighting

Luminaires, ballasts, lamps, and control devices required for general area lighting shall be in accordance with sheet No. 60 of Standard Detail No. 40-06-04, attached to these specifications.

##### 2.17.1 Roadway Lighting

Luminaires, ballasts, lamps, and control devices required for roadway lighting shall be in accordance with sheet 52 of Standard Detail No. 40-06-04, attached to these specifications.

##### 2.17.2 Lighting Poles

Lighting poles shall be a nominal 10 668 mm in length of steel. Poles shall be suitable for use with underground supply conductors. Poles shall be designed for a wind velocity of 90 mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-2. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. Bases shall be of the anchor-bolt mounted type. The type of pole shaft material provided shall not be mixed on any project.

##### 2.17.3 Brackets

Brackets for area lighting shall be of the indicated types. Brackets for floodlights shall have the number of tenons indicated. Brackets for roadway luminaires shall correctly position luminaires not less than 2438 mm from poles, at not less than the mounting heights indicated, but in no case less than 7 315 mm above any roadway. Slip-fitter brackets shall be coordinated with the luminaires provided, and brackets used with one type of luminaire shall be identical. Brackets shall be not less than 32 mm galvanized steel pipe or equivalent aluminum. On metal poles, brackets shall be of the same metal.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall conform to the requirements of Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

#### 3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and ANSI 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.

#### 3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

### 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 perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturer's instructions in accordance with paragraph 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.

##### 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 (manufacturer's standard product in lengths recommended for the specific size and type of duct) that is 6.3 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 203 mm 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. 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 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

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 or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

### 3.2.3 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with ANSI C2.

### 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. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

### 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 102 mm per 30 480 mm. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 457 mm for ducts of less than 76 mm diameter, and 914 mm for ducts 77 mm or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7620 mm 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 or handholes.

### 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

Each single duct requiring concrete encasement shall be completely encased in concrete with a minimum of 77 mm of concrete around each duct, except that only 51 mm of concrete are required between adjacent electric power or adjacent communication ducts, and ~~102~~ 152.4 mm of concrete shall be provided between adjacent electric power and communication ducts. 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, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 1524 mm below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15,240 mm (50 feet) in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1,219 mm on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 152 mm vertically.

### 3.5.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line but not less than 610 mm below finished grade and shall be installed with a minimum of 77 mm of earth around each duct, except that between adjacent electric power and communication ducts, 305 mm of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 77 mm layer of sand shall be laid first and compacted to

approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 152 mm. The first 152 mm layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 77-to-152 mm layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

### 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

#### 3.5.5.1 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 5-mil brightly colored plastic tape, not less than 77 mm in width and suitably inscribed at not more than 3048 mm on centers with a continuous metallic backing and a corrosion-resistant 1-mil metallic foil core to permit easy location of the duct line, shall be placed approximately 305 mm below finished grade levels of such lines.

## 3.6 MANHOLES, HANDHOLES, AND PULLBOXES

### 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. Frames and covers shall be delivered on the job unpainted and, after approval, shall be given 2 coats of asphalt paint. 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 13 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. Where duct lines enter manholes, the sections of duct may be either cast in the concrete or may enter the manhole through a square or rectangular opening of suitable dimensions provided in the manhole walls. Where openings are provided for the entrance of duct lines, the space between ducts and between ducts and manhole walls shall be caulked tight with lead wool or approved equal. 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 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

### 3.6.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 13 mm above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

### 3.6.6 Ground Rods

~~A ground rod shall be installed at the manholes, handholes and pullboxes. A~~  
minimum of one ground rod shall be installed for each of the manholes, handholes, pullboxes, and communications pedestals. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 102 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 tinned 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 manufacturers published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be carefully installed so as not to 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. Primary taps shall be set midpoint and adjusted up or down to obtain indicated secondary voltage. Secondary voltage shall be measured with typical building loads.

### 3.7.1 Concrete Pads

#### 3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or 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 102 mm above finished paving or grade and sloped to drain. Edges of concrete pads shall have 19 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 comply with the requirements of Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

#### 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.

#### 3.7.1.4 Pad Vault Combination

Modify this specification as appropriate when a vault is shown below pad.

### 3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed alike. Padlocks shall comply with ASTM F 883, Type EPC, Size 2.

## 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 1524 mm outside of a building and [ [610 mm610 mm below finished grade as specified and provided under Section 16415 ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

## 3.10 GROUNDING

### 3.10.1 Primary Grounding

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed 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 transformer to the ground mat.

### 3.10.2 Secondary Grounding

See site plan for secondary grounding system.

### 3.10.3 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 305 mm below finished grade.

### 3.10.4 Grounding and Bonding Connections

Connections above grade and below grade shall be made by the 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.

### 3.10.5 Grounding and Bonding Conductors

Grounding and bonding conductors include all 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.

### 3.10.4-6 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.

### 3.10.5-7 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in electrical-distribution-system manholes, handholes, or concrete pullboxes 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. Communications Pedestals shall be grounded from the associated ground rod to the bus bar in the Pedestal by a flexible #10 AWG copper wire. Bond Pedestal as required by manufacturer. 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 51 mm above and 152 mm below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

### 3.10.6-8 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 610 mm of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

### 3.10.7-9 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 610 mm.

### 3.10 (NOT USED)

## 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. All 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 each grounding electrode system 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. Multiple rod electrodes - 25 ohms.

#### 3.11.4 Ground Connection Inspection

All below-grade ground-mat connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 2 hours before the site is ready for inspection.

#### 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.

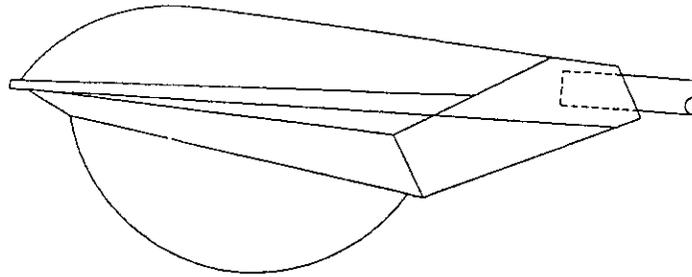
#### 3.11.6 Operating Tests

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 SUBMITTALS Test Reports.

#### 3.12 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~~



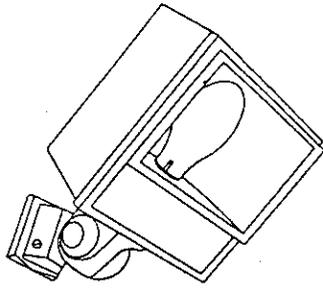
## TYPE 402

Enclosed, Heavy Duty, Integrally Ballasted,  
High Intensity Discharge Roadway Lighting Fixture

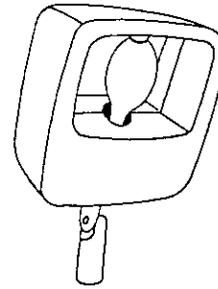
First Suffix	Second Suffix	Description
A		Rated for mercury lamp
B		Rated for metal halide lamp
C		Rated for high pressure sodium lamp
	1	IES type I medium light distribution
	2	IES type II medium light distribution
	3	IES type III medium light distribution
	4	IES type IV medium light distribution
	5	IES type V medium light distribution

Fixture shall conform to UL 1572, and ANSI C136.10 as specified below. Fixture housing shall be of die-cast aluminum with the bottom plate hinged to the top housing. The bottom plate shall be held in place by hinge and spring latch and shall have a continuous, weather-tight gasket that filters air entering or leaving the optical and power compartment. The housing finish shall be baked enamel. The fixture shall have an integral slip-fitter to accept a 1-1/2-inch to 2-inch mast arm. The reflector shall be aluminum of the manufacturer's standard commercial product finish suitable for the type and rating of the lamp. The lens shall be tempered prismatic glass and shall be held securely in the bottom plate. The fixture shall be provided with the locking-type mounting receptacle for photoelectric control in accordance with ANSI C136.10. Photocell shall be provided on top of fixture. Ballast shall be of the high power factor type. Ballast shall be of the constant wattage autotransformer type for mercury vapor lamps, the leadpeak regulated type for metal halide lamps, and the regulated type for high pressure sodium lamps. Ballast shall be capable of starting the lamp at ambient temperatures ranging from minus 20 degrees F to 105 degrees F. The fixture shall be prewired, and shall have a mogul base glazed porcelain lampholder.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPE 506  
Wall Bracket Mounting



TYPE 507  
Slip Fitter Mounting

High Intensity Discharge Floodlight with Asymmetrical Light Distribution

First Suffix	Second Suffix	Third Suffix	Description
A			Rated for metal halide lamp
B			Rated for high pressure sodium (HPS) lamp
	1		NEMA type 6 x 5 light distribution
	2		NEMA type 7 x 7 light distribution
	3		NEMA type 7 x 6 light distribution
		A	Fixture with instant restrike feature
		B	Type 300 emergency unit

Fixture shall conform to UL 1572 and NEMA FA 1, and shall be the heavy-duty, enclosed type. Fixture shall consist of a cast aluminum housing and a cast aluminum door assembly and shall be integrally ballasted unless otherwise shown or approved. The door assembly shall be hinged and gasketed and held in a closed position with screws of finish to match fixture or recessed stainless steel latches. The lens shall be thermal shock and impact resistant tempered glass and shall be held securely in the door frame. Reflector shall be aluminum with manufacturer's standard commercial product finish suitable for light source provided. All metallic parts of the fixture shall receive one or more rust-inhibitive coatings prior to the application of interior and exterior finishes in accordance with the standard practice of the manufacturer for commercially available exterior lighting fixtures. Ballast shall be of the high power factor type capable of starting and operating the lamp in an ambient temperature of minus 20 degrees F to 105 degrees F. Ballast shall be of the lead-peak autotransformer type for metal halide lamps and the regulating type for high pressure sodium lamps. If an instant restrike feature is specified, the fixture shall be equipped to permit restarting of the lamp to full lumen output within 5 seconds following restoration of power after each momentary power interruption. The fixture shall be prewired and shall include a mogul base glazed porcelain lampholder. Mounting hardware for the fixture shall be adjustable, and shall be the cast aluminum type unless otherwise approved.

Fixture types indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

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## SECTION 16415

## ELECTRICAL WORK, INTERIOR

## PART 1 GENERAL

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 (1988) Code for Electricity Metering
- ANSI C12.4 (1984) Mechanical Demand Registers
- ANSI C12.10 (1987) Electromechanical Watthour Meters
- ANSI C12.11 (1987) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
- ANSI C39.1 (1981) Electrical Analog Indicating Instruments
- ANSI C57.12.50 (1981; R 1989) Ventilated Dry-Type Distribution Transformers, 1 to 500 kVA, Single-Phase, and 15 to 500 kVA, Three-Phase, with High-Voltage, 601 to 34,500 Volts, Low-Voltage 120 to 600 Volts
- ANSI C82.1 (1985; C82.1a-1990; C82.1b-1990; C82.1c-1990) Ballasts for Fluorescent Lamps
- ANSI C82.4 (1985; C82.4a-1988) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple Supply Type)
- ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

## FEDERAL COMMUNICATIONS COMMISSION (FCC)

- FCC Part 68 (Jul 1986) Rules and Regulations: Connection of Terminal Equipment to the Telephone Network

## FEDERAL SPECIFICATIONS (FS)

- FS L-C-530 (Rev C) Coating, Pipe, Thermoplastic Resin
- FS L-P-387 (Rev A; Am 1, Int Am 2) Plastic Sheet, Laminated, Thermosetting (for Designation Plates)

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE C57.13 (1978; R 1986) Instrument Transformers
- IEEE C57.94 (1982; R 1987) Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers

IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576 (Sep 1988; 2nd Ed) Communications Wire and Cable for Wiring of Premises

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1985; Rev 1 & 2, ICS 6) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA AB 1 (1986; Rev 1) Molded Case Circuit Breakers and Molded Case Switches

NEMA ICS 1 (1988; Rev 1 & 2) Industrial Controls and Systems

NEMA ICS 2 (1988; Rev 1) Industrial Control Devices, Controllers and Assemblies

NEMA ICS 3 (1988; Rev 1) Industrial Systems

NEMA ICS 6 (1988; Rev 1) Enclosures for Industrial Control and Systems

NEMA LE 4 (1987) Recessed Luminaires, Ceiling Compatibility

NEMA MG 1 (1987; Rev 1) Motors and Generators

NEMA MG 10 (1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors

NEMA OS 1 (1989) Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports

NEMA OS 2 (1986; Errata Aug 15, 1986) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

NEMA PB 1 (1990; PB 1.1-1986) Panelboards

NEMA PB 2 (1989; PB 2.1-1986) Deadfront Distribution Switchboards

NEMA RN 1 (1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA ST 20 (1986) Dry-Type Transformers for General Applications

NEMA TC 2 (1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NEMA TC 13 (1986) Electrical Nonmetallic Tubing (ENT)

NEMA WD 1 (1983; R 1989) General Requirements for Wiring Devices

NEMA WD 6 (1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 101 (1996) Safety to Life from Fire in Buildings and Structures

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA TE&CM 823 (Aug 1980; Issue No. 3) Electrical Protection by Use of Gas Tube Arresters

UNDERWRITERS LABORATORIES (UL)

UL-03 (1990; Supple) Electrical Construction Materials Directory

UL 1 (Aug 28, 1985; 8th Ed) Flexible Metal Conduit

UL 6 (Oct 23, 1981; 9th Ed; Rev thru Nov 22, 1989) Rigid Metal Conduit

UL 20 (Jun 12, 1986; 10th Ed; Rev thru Feb 20, 1991) General-Use Snap Switches

UL 44 (Aug 29, 1983; 12th Ed; Rev thru Dec 7, 1990) Rubber-Insulated Wires and Cables

UL 50 (Sep 8, 1988; 9th Ed; Rev thru Mar 28, 1991) Cabinets and Boxes

UL 67 (Oct 12, 1988, 10th Ed; Rev thru Jun 27, 1990; Errata Aug 21, 1990) Panelboards

UL 83 (Sep 26, 1983; 9th Ed; Rev thru Dec 11, 1990) Thermoplastic-Insulated Wires and Cables

UL 94 (Jan 24, 1980; 3rd Ed; Rev thru Mar 19, 1990) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 98 (Jan 13, 1987; 11th Ed; Rev thru Apr 20, 1990) Enclosed and Dead-Front Switches

UL 133 (Jun 9, 1987; 8th Ed; Rev thru Nov 8, 1988) Wires and Cables with Varnished-Cloth Insulation

UL 360 (Aug 18, 1986; 3rd Ed; Rev Feb 20, 1990) Liquid-Tight Flexible Steel Conduit

UL 467 (Nov 22, 1984; 6th Ed; Rev thru Nov 14, 1986) Grounding and Bonding Equipment

UL 486A (Nov 24, 1980; 7th Ed; Rev thru Oct 12, 1989) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486C (Dec 30, 1983; 1st Ed; Rev thru Oct 12, 1989) Splicing Wire Connectors

UL 489 (Sep 15, 1986; 7th Ed; Rev thru Oct 4, 1990) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

UL 497 (Dec 15, 1978; 4th Ed; Rev thru Oct 9, 1984) Protectors for Communications Circuits

UL 498 (Apr 15, 1991; 12th Ed) Attachment Plugs and Receptacles

UL 506 (Dec 22, 1989; 10th Ed) Specialty Transformers

UL 508 (Sep 26, 1989; 15th Ed; Rev thru Mar 26, 1991) Industrial Control Equipment

UL 510 (Oct 6, 1986; 6th Ed; Rev Oct 7, 1986) Insulating Tape

UL 512 (Feb 16, 1987; 9th Ed) Fuseholders

UL 514A (Dec 1, 1983; 7th Ed; Rev thru Jul 18, 1990) Metallic Outlet Boxes

UL 514B (Mar 15, 1989; 2nd Ed; Rev thru Aug 9, 1990) Fittings for Conduit and Outlet Boxes

UL 514C (Oct 31, 1988; 2nd Ed; Rev Jun 13, 1989) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 542 (May 23, 1985; 6th Ed; Rev Apr 29, 1991) Lampholders, Starters, and Starter Holders for Fluorescent Lamps

UL 651 (Aug 3, 1989; 5th Ed; Rev thru Dec 4, 1989) Schedule 40 and 80 Rigid PVC Conduit

UL 651A (Aug 10, 1989; 2nd Ed; Rev Aug 11, 1989) Type EB and A Rigid PVC Conduit and HDPE Conduit

UL 674 (Jun 23, 1989; 2nd Ed) Electric Motors and Generators for Use in Hazardous (Classified) Locations

UL 698 (Apr 23, 1991; 11th Ed) Industrial Control Equipment for Use in Hazardous (Classified) Locations

UL 719 (Aug 19, 1985; 9th Ed; Rev thru Dec 20, 1990) Nonmetallic-Sheathed Cables

UL 797 (Oct 10, 1983; 5th Ed) Electrical Metallic Tubing

- UL 817 (Dec 22, 1986; 9th Ed; Rev thru Jan 23, 1989) Cord Sets and Power-Supply Cords
- UL 844 (Nov 29, 1990; 10th Ed; Rev thru Nov 30, 1990) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
- UL 845 (Feb 18, 1988; 3rd Ed; Rev thru Aug 1, 1989) Motor Control Centers
- UL 869A (Mar 23, 1987; 1st Ed; Rev thru Nov 23, 1990) Service Equipment
- UL 877 (Aug 15, 1985; 3rd Ed; Rev thru Mar 23, 1987) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
- UL 886 (Jun 12, 1985; 9th Ed; Rev thru Apr 14, 1991) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
- UL 891 (Nov 13, 1984; 8th Ed; Rev thru Mar 7, 1991) Dead-Front Switchboards
- UL 924 (Nov 29, 1990; 7th Ed; Rev Nov 30, 1990) Emergency Lighting and Power Equipment
- UL 935 (Oct 19, 1984; 7th Ed; Rev thru Jul 17, 1990; Errata Oct 5, 1990) Fluorescent Lamp Ballasts
- UL 943 (Sep 11, 1985; 2nd Ed) Ground-Fault Circuit Interrupters
- UL 1004 (May 12, 1989; 4th Ed; Rev Nov 2, 1989) Electric Motors
- UL 1010 (Feb 26, 1991; 5th Ed; Rev May 15, 1991) Receptical-Plug Combinations for Use in Hazardous (Classified) Locations
- UL 1029 (Dec 1, 1986; 4th Ed; Rev thru May 21, 1990) High-Intensity-Discharge Lamp Ballasts
- UL 1242 (Oct 10, 1983; 1st Ed; Rev Nov 23, 1989) Intermediate Metal Conduit
- UL 1561 (Jan 9, 1986; 1st Ed; Rev thru Jan 29, 1991) Dry-Type General Purpose and Power Transformers
- UL 1570 (Apr 11, 1988; 3rd Ed; Rev thru May 25, 1991) Fluorescent Lighting Fixtures
- UL 1571 (Feb 7, 1984; 2nd Ed; Rev thru Mar 19, 1991) Incandescent Lighting Fixtures
- UL 1572 (Dec 10, 1984; 2nd Ed; Rev thru Mar 19, 1991; Errata Aug 22, 1990) High Intensity Discharge Lighting Fixtures

UL 1660 (Sep 17, 1987; 1st Ed) Liquid-Tight Flexible Nonmetallic Conduit

## 1.2 GENERAL

### 1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated herein or shown.

### 1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Electrical Contractor shall coordinate the electrical work with HVAC and electrical drawings and provide all power related wiring even if they are not shown on electrical drawings.

### 1.2.3 Hazardous Locations

Wiring in locations indicated shall conform to the NFPA 70.

### 1.2.4 Standard Products

Material and equipment shall be a 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.

### 1.2.5 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, all identification nameplates shall be made of laminated plastic in accordance with FS L-P-387 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, 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. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The following equipment, as a minimum, shall be provided with identification nameplates:

	<u>Minimum 3.2 mm High Letters</u>
Panelboards	Control Power Transformers Starters
Control Devices	Instrument Transformers
	16415-6

Safety Switches

Main Distribution Panel  
Transformers  
Equipment Enclosures  
Switchgear  
Switchboards  
Motors

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

#### 1.2.6 As-Built Submittals

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as built drawings to the Contracting Officer.

#### 1.3.1 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 SUBMITTALS:

##### Drawings

Electrical Work; GA.

Detail drawings for all materials and equipment specified. Detail drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required. Drawings shall show applicable schematic diagrams; and equipment layout and anchorage

##### Reports

Materials and Equipment; GA.

The label or listing of the Underwriters Laboratories, Inc., shall be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Materials and equipment shall be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

#### 1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section.

##### 2.1.2 Cables and Wires

Conductors in cables shall be annealed copper, except that AA-8000 series aluminum conductors may be used as an equivalent for copper conductors of No. 6 AWG or larger. Intermixing of copper and aluminum conductors in these sizes is not permitted. Design is based on copper conductors and aluminum conductors shall have an ampacity not less than that of the indicated copper conductors. Cables shall be single-conductor type, unless otherwise indicated. Cables and wires shall conform to UL 44 for rubber-insulated type; UL 83 for the thermoplastic-insulated type; UL 133 for varnished-cloth insulated type; and UL 719 for the nonmetallic-sheathed cables. The following types shall be provided.

##### 2.1.2.3 Service Entrance Cable

Type USE,

##### 2.1.2.4 Grounding Cables

Grounding cables shall be bare or shall have green low-voltage insulation.

##### 2.1.2.5 Cord Sets and Power-Supply Cords

UL 817.

##### 2.1.9 Circuit Breakers

Circuit breakers shall have voltage, current and interrupting ratings as indicated.

##### 2.1.9.1 Molded-Case and Insulated-Case Circuit Breakers

NEMA AB 1 and UL 489 for circuit breakers, and UL 877 for circuit breakers and circuit breaker enclosures in hazardous (classified) locations.

a. Molded-Case Circuit Breakers: Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multipole breakers shall be of the common-trip type having a single operating handle, but for sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multipole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. Breakers coordinated with current-limiting fuses shall have a combined interrupting capacity of 100,000 symmetrical amperes. All poles of associated breakers shall open if any fuse blows.

### 2.1.9.3 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

### 2.1.10 Conduit and Tubing

#### 2.1.10.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797.

#### 2.1.10.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

#### 2.1.10.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

#### 2.1.10.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660

#### 2.1.10.5 Intermediate Metal Conduit

UL 1242.

#### 2.1.10.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

#### 2.1.10.7 Rigid Metal Conduit

UL 6.

#### 2.1.10.8 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

### 2.1.11 Conduit and Device Boxes and Fittings

#### 2.1.11.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

#### 2.1.11.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

#### 2.1.11.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

#### 2.1.11.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

#### 2.1.11.5 Fittings for Conduit and Outlet Boxes

UL 514B.

#### 2.1.11.6 Fittings for Use in Hazardous (Classified) Locations

UL 886.

#### 2.1.11.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

#### 2.1.13 Connectors, Wire Pressure

##### 2.1.13.1 Copper Conductors

UL 486A.

##### 2.1.13.2 Aluminum Conductors

UL 486B.

#### 2.1.14 Electrical Grounding and Bonding Equipment

UL 467.

##### 2.1.14.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 in diameter by 3048 mm in length driven full length into the earth.

##### 2.1.14.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

#### 2.1.15 Enclosures

NEMA ICS 6 or NEMA 250 or UL 698 for use in hazardous (classified) locations, unless otherwise specified.

##### 2.1.15.1 Cabinets and Boxes

UL 50.

##### 2.1.15.2 Circuit Breaker

UL 489.

##### 2.1.15.3 Circuit Breaker for Use in Hazardous (Classified) Locations

UL 877.

#### 2.1.16 Fixtures, Lighting and Fixture Accessories/Components

Standard Drawing 40-06-04 sheets referenced hereinafter and enclosed as an integral part of these specifications, additional fixtures shown on contract drawings, if any and UL 844 for fixtures to be installed in hazardous (classified) locations. Fixtures, accessories and components, including

ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.1.16.1 Fixture, Auxiliary or Emergency

UL 924.

2.1.16.2 Incandescent Fixture

NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

2.1.16.3 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570.

b. Ballast High-Power Factor, Class P, Automatic-Resetting Type: ANSI C82.1 and UL 935. Fluorescent lamp ballasts shall have a Ballast Efficacy Factor (BEF) not less than that shown below:

**FLUORESCENT BALLAST EFFICACY FACTORS**

Design starting temperature above 40 degrees F, with 60 Hz input frequency

<u>NUMBER OF LAMPS</u>	<u>LAMP TYPE</u>	<u>NOMINAL OPERATIONAL INPUT VOLTAGE</u>	<u>MAX. LAMP OPERATING CURRENT</u>	<u>MIN. BALLAST EFFICACY FACTORS</u>
1	4 ft rapid start	120 - 277	less than 1000 m amp	1.805
2	4 ft rapid start	120	less than 1000 m amp	1.060
2	4 ft rapid start	227	less than 1000 m amp	1.050
2	8 ft slim-line	120 - 277	less than 1000 m amp	1.570
2	8 ft high output rapid start	120 - 277	less than 1000 m amp	1.570

c. Lampholders, Starters, and Starter Holders: UL 542.

## 2.1.16.4 High-Intensity-Discharge

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

## 2.1.17 Fuses and Fuseholders

## 2.1.17.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

## 2.1.17.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

UL 198C.

## 2.1.17.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

## 2.1.17.4 Fuses, Class H

UL 198B.

## 2.1.17.5 Fuses, Class R

UL 198E.

## 2.1.17.6 Fuses, Class T

UL 198H.

2.1.17.7 Fuses, Plug Type

UL 198F.

2.1.17.8 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.1.17.9 Fuses, D-C for Industrial Use

UL 198L.

2.1.17.10 Fuseholders

UL 512.

2.1.18 Instruments, Electrical Indicating

ANSI C39.1.

NEMA MG 1 and UL 1004 for motors and NEMA MG 10 for energy management selection of polyphase motors , and UL 674 for use of motors in hazardous (classified) locations.

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845.

2.1.19 Motors, AC, Fractional and Integral Horsepower (500 Hp and Smaller)

NEMA MG 1 and UL 1004 for motors and NEMA MG 10 for energy management selection of polyphase motors, and UL 674 for use of motors in hazzardous (classified) locations.

2.1.20 Motor Controls and Motor Control Centers

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845.

2.1.20.1 Horsepower Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.1.20.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors not indicated or specified elsewhere to be standard or high efficiency type should be determined on the basis of expected operating hours.

**Minimum Motor Efficiencies**

HP	Standard. Efficiency	High Efficiency
1	77.0	85.5
1.5	78.5	85.5
2	78.5	85.5
3	78.5	88.5
5	82.5	88.5
7.5	84.0	90.0
10	85.5	90.0
15	85.5	91.0
20	87.5	92.0
25	88.5	92.0

## 2.1.21 Panel boards

Dead-front construction, NEMA PB 1 and UL 67.

## 2.1.22 Receptacles

## 2.1.22.1 Spec Grade

NEMA WD 1.

## 2.1.22.2 Ground Fault Interrupters

UL 943, Class A or B.

## 2.1.22.3 Hazardous (Classified) Locations

UL 1010.

## 2.1.23 Service Equipment

UL 869A.

## 2.1.24 Splice, Conductor

UL 486C.

## 2.1.25 Switchboard, Dead Front Distribution

NEMA PB 2 and UL 891.

## 2.1.26 Snap Switches

UL 20.

#### 2.1.27 Tapes

##### 2.1.27.1 Plastic Tape

UL 510.

##### 2.1.27.2 Rubber Tape

UL 510.

#### 2.1.28 Transformers

##### 2.1.28.1 Conventional Dry-Type

IEEE C57.12.01, ANSI C57.12.10, IEEE C57.12.80, IEEE C57.12.91, IEEE C57.94, IEEE C57.98, IEEE C57.105 and UL 1561 in addition to the specific standards referenced below.

a. Specialty or General Applications: NEMA ST 20 and UL 506 unless otherwise shown or specified.

b. Instrument: ANSI C12.11 and IEEE C57.13 with current ratio or voltage ratings needed for metering required.

#### 2.1.29 Wiring Devices

NEMA WD 1 for general-purpose wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

### PART 3 EXECUTION

#### 3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the Specifications Section 16375.

##### 3.1.1 Grounding Conductors

A GREEN GROUND WIRE SHALL BE FURNISHED REGARDLESS OF THE TYPE OF CONDUIT. ALL EQUIPMENT GROUNDING CONDUCTORS, INCLUDING METALLIC RACEWAY SYSTEMS USED AS SUCH, SHALL BE BONDED OR JOINED TOGETHER IN EACH WIRING BOX OR EQUIPMENT ENCLOSURE. INSURE THAT ALL METALLIC RACEWAYS AND GROUNDING CONDUCTORS ARE ACTUALLY WIRED OR BONDED INTO A COMMON JUNCTION. METALLIC BOXES AND ENCLOSURES, IF USED, SHALL ALSO BE BONDED TO THESE GROUNDING CONDUCTORS BY AN APPROVED MEANS PER NFPA 70. WHEN BOXES FOR RECEPTACLES, SWITCHES, OR OTHER UTILIZATION DEVICES ARE INSTALLED, ANY DESIGNATED GROUNDING TERMINAL ON THESE DEVICES SHALL ALSO BE BONDED TO THE EQUIPMENT GROUNDING CONDUCTOR JUNCTION WITH A SHORT JUMPER.

#### 3.2 WIRING METHODS

##### 3.2.1 General Requirements

Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid aluminum or rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic and/or nonmetallic tubing, or intermediate metal conduit.

### 3.2.2 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 13 mm. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing may be installed only within buildings. Electrical metallic tubing may be installed in concrete and grout in dry locations. Electrical metallic tubing installed in concrete or grout shall be provided with concrete tight fittings. EMT will not be installed in damp or wet locations. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 152 mm away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

#### 3.2.2.1 Below Slab-on-Grade or in the Ground

All electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field-wrapped with 0.25 mm thick pipe-wrapping plastic tape applied with a 50-percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

#### 3.2.2.2 Installing in Slabs Including Slabs on Grade

Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer.

#### 3.2.2.3 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

#### 3.2.2.4 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

#### 3.2.2.5 Supports

Metallic conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 3048 mm and within 914 mm of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, or ceiling trapeze. C-clamps or beam clamps shall have strap or rod-type retainers. Rigid plastic conduits (if permitted as a wiring method) shall be supported as indicated above, except that they will be supported at intervals as indicated in NFPA 70. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Holes cut to a depth of more than 38 mm in reinforced concrete beams or to a depth of more than 19 mm in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Conduit shall not be supported using wire or nylon ties. Raceways shall be installed as a complete system and be independently supported from the structure. Upper raceways shall not be the support of lower raceways. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by the NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. A pull wire shall be inserted in each empty raceway in which wiring is to be installed by others if the raceway is more than 15 240 mm (50 feet) in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 45 720 mm (150 feet) in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200-pound tensile strength. Not less than 254 mm of slack shall be left at each end of the pull wire. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

#### 3.2.2.6 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 3045 mm.

#### 3.2.2.7 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirements that no length of run shall exceed 15 240 mm (50 feet) for 13 mm

and 19 mm sizes, and 30 480 (100 feet) for 25.4 mm or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 25 mm size or larger shall be not less than ten times the nominal diameter.

### 3.2.3 Cable Systems

Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 1219 mm above floors shall be protected from mechanical injury by installation in conduit or tubing.

### 3.2.4 Cables and Conductors

Aluminum conductors shall have ampacity of not less than the copper conductors. Wire connectors of insulating material or solderless pressure connectors properly taped shall be utilized for all splices. Pressure connectors for aluminum conductors shall have tinned aluminum bodies. Aluminum contact surfaces of conductors and connectors shall be cleaned and covered with antioxidant compound prior to making of connections.

#### 3.2.4.1 Sizes

All sizes are based on copper conductors, unless otherwise indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 30 480 mm (100 feet) long and of 277 volts more than 70 104 mm (230 feet) long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG.

The conductor sizes are based on the use of TW insulation for conductors smaller than No. 1/0 AWG and THW insulation for conductors No. 1/0 and larger, except where otherwise indicated.

Higher temperature rated conductors shall be permitted to be used, if the UL tested temperature ratings for which the equipment in the circuit is marked are not exceeded.

Conductor sizes for nonlinear loads shall be based on the use of minimum 75 degrees C insulated conductors for branch circuits and feeders.

#### 3.2.4.2 Power Conductor Identification

All phase conductors shall be identified by color-coding. The color of the insulation on the phase conductors of different voltage systems shall be as follows:

120/208 volt, 3-phase: black, red, and blue.

277/480 volt, 3-phase: Brown, orange, and yellow.

120/240 volt, single/phase: Black and red.

Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 76 mm of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

#### 3.2.4.3 Control Conductor Identification

CONTROL CIRCUIT CONDUCTOR IDENTIFICATION SHALL BE MADE BY COLOR-CODED INSULATED CONDUCTORS, PLASTIC-COATED SELF-STICKING PRINTED MARKERS, PERMANENTLY ATTACHED STAMPED METAL FOIL MARKERS, OR EQUIVALENT MEANS AS APPROVED. CONTROL CIRCUIT TERMINALS OF EQUIPMENT SHALL BE PROPERLY IDENTIFIED. TERMINAL AND CONDUCTOR IDENTIFICATION SHALL MATCH THAT SHOWN ON APPROVED DETAIL DRAWINGS. HAND LETTERING OR MARKING IS NOT ACCEPTABLE.

#### 3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways, 102 mm by 102 mm nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Large size boxes shall be NEMA 1 or as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic-sheathed cable system, when permitted by NFPA 70. In partitions of light steel construction bar hangers with 25 mm long studs, mounted between metal wall studs or metal stud "C" brackets snapped on and tab-locked to metal wall studs, shall be used to secure boxes to the building structure. When "C" brackets are used, additional box support shall be provided on the side of the box opposite the brackets. The edges of boxes for electrical devices shall be flush with the finished surfaces in gypsum and plasterboard installations. Boxes for mounting lighting fixtures shall be not less than 102 mm square except smaller boxes may be installed as required by fixture configuration, as approved. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be flush with the top of a block to minimize cutting of blocks, and boxes shall be located horizontally to avoid cutting webs of block. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 1219 mm above finished floors. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet

metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Cast-metal boxes with 2.38 mm wall thickness are acceptable. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 610 mm from the box. Penetration of more than 38 mm into reinforced-concrete beams or more than 19 mm into reinforced-concrete joists shall avoid cutting any main reinforcing steel.

### 3.3.1 Pull Boxes

Pull boxes of not less than the minimum size required by the NFPA 70 shall be constructed of aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified above. Boxes shall be furnished with screw-fastened covers. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.

### 3.3.2 Conduit Stub-Ups

Conduits stubbed up through concrete floors for connections to freestanding equipment shall be provided with a short elbow and an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 152 mm above the floor. Screwdriver-operated threaded flush plugs shall be installed in conduits from which no equipment connections are made to suit the devices installed.

## 3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of satin finish corrosion resistant steel or of satin finish chromium plated brass.† Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of .159 mm. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

## 3.5 RECEPTACLES

### 3.5.1 Single and Duplex

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of brown or ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be the UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided everywhere as required by

the National Electrical Code and in addition all the following receptacle locations; exterior including those on roofs, bathrooms with showers, shops, hangars, and garages.

### 3.5.2 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

## 3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall harmonize with the color of the respective wall. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red.

## 3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type as indicated with external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

## 3.8 PANELBOARDS

Circuit breakers and switches used as a motor disconnecting means, and not in sight of the motor and the driven machinery location, shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

### 3.8.1 Panel boards

Panel boards shall be circuit breaker equipped. Switches serving as motor disconnect means shall be horsepower rated in conformance with UL 98. A ground bus shall be provided in each panelboard.

## 3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacturer of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting-capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

### 3.9.1 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK5 shall have tested interrupting capacity not less than 100,000 amperes. Fuse-holders shall be the type that will reject all Class H fuses.

### 3.10 UNDERGROUND-SERVICE CONDUITS

Empty conduits for underground electric-service cable and telephone cable shall be installed as indicated. Except where otherwise indicated, conduits shall terminate approximately 1524 mm beyond the building wall and 610 mm below finished grade, with the outside ends bushed and plugged or capped.

### 3.11 MOTORS

Motors shall be as specified in Paragraph MATERIALS AND EQUIPMENT for Motors, AC, Fractional and Integral Horsepower (500 Hp and Smaller), whether or not motors are separately provided or included in equipment assemblies specified in other sections of these specifications. Each motor shall conform to the HP and voltage ratings indicated, and shall have a service-factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40-degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

### 3.12 MOTOR CONTROL

Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8-hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single- or double-pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual- and automatic-control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed

when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

#### 3.12.1 Motor Control Centers

Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class 1, Type B. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Combination starters shall be provided with circuit breakers

#### 3.12.2 Contacts

Contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

#### 3.12.3 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120-volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120-volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

#### 3.13 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double-pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

#### 3.14 CONVENTIONAL DRY-TYPE TRANSFORMERS

Transformers having the primary or higher-voltage winding rated at 600 volts or less and a secondary or lower-voltage winding rated at 240 volts or less may be manufacturer's standard ventilated or enclosed, self-cooled type of transformer unless otherwise shown, specified or required for proper and safe application. Transformers shown with primary ratings in excess of 600 volts shall have the NEMA 220-degree C insulation and shall be rated for a temperature rise of 80 degrees C above ambient. Similarly, transformers having primary windings rated at 480 volts or less and a kVA rating of 150 or larger shall have Class H insulation and be suitable for an 80-degree C temperature rise above ambient. The percent voltage impedance for the transformer shown to supply all facility power demands shall be 5.75 as required to limit the available fault current to less than the ampere-interrupting-capacity of the equipment supplied through the power supply transformer shown. These distribution transformers shall have a basic impulse

level (BIL) rating [not less than the ANSI standard BIL rating for the mineral-oil insulated type of transformer having the same voltage classification or rating as the dry-type of transformer proposed for installation

### 3.15 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

#### 3.15.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

##### 3.15.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

##### 3.15.1.2 Fluorescent

Fluorescent lamps shall have standard cool-white color characteristics and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved.

##### 3.15.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be the high-pressure-sodium type unless otherwise indicated, shown, or approved.

#### 3.15.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on Standard Drawing No. 40-06-04, Sheet Nos. 15, 25, and 71 which accompany and form a part of this specification for the types indicated. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light-distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

##### 3.15.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

##### 3.15.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants rods or chains 1219 mm or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous-row fluorescent units shall

have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 3048 mm. Rods shall be of not less than 4.76 mm diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

#### 3.15.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL-03. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

#### 3.15.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

### 3.16 EQUIPMENT CONNECTIONS

All wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 1829 mm or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

#### 3.16.1 Motors and Motor Control

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.

### 3.17 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

### 3.18 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage

of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

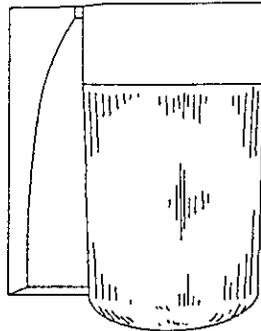
### 3.19 TESTS

After the interior-wiring-system 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 of this specification. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power. No part of the electrical distribution system shall be energized prior to the resistance testing of that systems ground rods and submission of test results to the Contracting Officer. Test reports shall indicate the location of the rod and the resistance and the soil conditions at the time the test was performed.

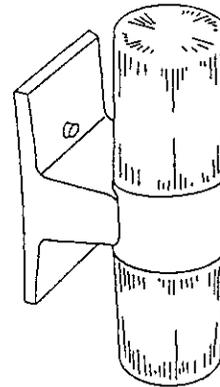
### 3.20 ONE-LINE DIAGRAM

Provide a one-line diagram with main transformer, building disconnect means, and feeder breakers/switches to building panels located at the building disconnect. Diagram shall be mounted under glass or shall be plastic laminated. The breaker/switch identification on the diagram shall match nameplate on the installed equipment.

~~END OF SECTION~~



TYPE 124  
Rated for One 100 Watt Lamp



TYPE 125  
Rated for Two 100 Watt Lamps

Exterior Wall Mounted Enclosed and Gasketed  
Incandescent Fixtures For Wet Locations

Suffix

A  
B

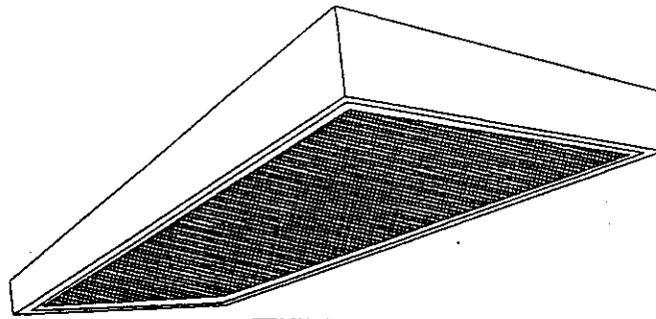
Description

Without protective guard  
With protective guard

Fixture shall conform to UL 1571. Fixture shall be suitable for use in wet locations and shall be enclosed and gasketed. The round housing and wall bracket shall be cast aluminum provided with a brushed or satin aluminum finish and a clear acrylic lacquer protective coating. The lampholder shall be medium base glazed porcelain. The housing shall be threaded to receive the threaded globe. The globe shall be white opal tempered glass. The protective guard shall be cast aluminum and finished as specified for housing. Fixture shall be prewired.

Fixture types indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

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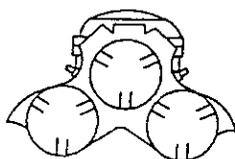
TYPE 213

Surface, Ceiling Mounted Fluorescent Fixture, 1-foot by 4-foot

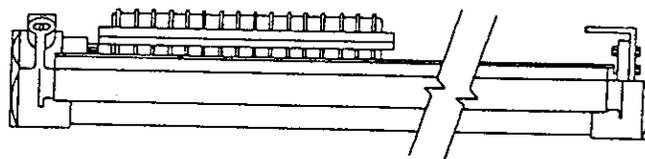
First Suffix	Second Suffix	Third Suffix	Description
A			Single lamp
B			Two lamps
	1		45x45 Light-Stabilized Polystyrene egg crate louver
	2		35x25 Parabolic Aluminized Louver
	3		Prismatic Acrylic Lens Flat 0.125 inch nominal thickness
		A	Type 200 emergency unit

Fixture shall conform to UL 1570. Housing shall be cold-rolled steel. The lens or louver shall be installed in a manner that will prevent it from coming loose due to vibration. The ballasts and wiring shall be enclosed in a wireway that is continuous throughout the length of the fixture and which forms a wireway for circuits through the fixture. All metal parts shall receive a rust inhibitive coating before application of the finish coat. The finish coat shall be baked white enamel. Standard ballast(s) shall be the Class P, high power factor type which has been approved for the application by the Certified Ballast Manufacturers. Fixture shall be prewired.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



Left End View



Side View

## TYPE 709

Four-Foot Industrial Lighting Fixture for use in Class I, Div. 1 and 2, Groups C and D; Class II, Div. 1 and 2, Groups E, F, and G, and Class III Locations.

First Suffix	Description	Second Suffix	Description
A	Two Lamps	1	Rated for rapid start 40 watt, 430 mA lamps
B	Four Lamps	2	Rated for 60 watt, 800 mA lamps
		3	Rated for 110 watt, 1500 mA lamps

Fixture shall conform to UL 595 and 844. Fixture shall be suitable for locations where hazardous fumes, gases, or dust are present, and for wet locations if specified in other contract documents. Fixture, excluding reflectors, shall be constructed of copper-free aluminum and shall be provided with lamps, tempered, heat and impact resistant lamp tubes. Reflectors shall be heavy gauge extruded aluminum which shall have a high gloss reflective finish. Fixture shall be capable of being relamped from either end and shall be provided with lamp guides at each end for ease of relamping. Lamp access covers shall be interchangeable, screw type, with neoprene, "O-ring" seals. Sockets on both ends shall be spring loaded for maximum shock and vibration protection, and shall be the T-12 medium Bi-pin type for the 40 watt lamps and the T-12 recessed type for the 60 and 110 watt lamps unless otherwise approved. Ballast shall be Class P thermally protected. Replacement of ballast shall be feasible with fixture in place. Fixture shall be factory sealed and shall be suitable for vertical or horizontal mounting with 360° rotation permissible. Fixture shall have 90° and 45° mounting provisions as standard.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

## 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.

## NACE INTERNATIONAL

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 (1996) 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 NACE International 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 PROTECTION

Cathodic protection by sacrificial anode shall be provided for buried valves, fittings, fire hydrants, connectors, or other structure isolated by non-metallic pipe as indicated on the drawings.

#### 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:

##### Data

Cathodic Protection System; GA.

Manufacturer's Catalog Data.

Qualifications; FIO.

Evidence of qualifications of the corrosion engineer.

##### Drawings

Cathodic Protection System; GA.

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; FIO.

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 Type II or Type III 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
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.
Magnesium	Balance	Balance	Balance	Balance

## 2.1.2 Connecting Wire

Wire shall be No. 12 AWG solid copper wire, not less than 3 m (10 feet) long, unspliced, complying with NFPA 70, Type TW 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.

## 2.1.3 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. 10 AWG stranded copper wire with HMWPE 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 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

## 2.2.3 Joint, Patch, Seal, and Repair Coating

16640-3

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 (1/2-inch) thick. Coating compound shall be cold-applied coal-tar base mastic or hot-applied coal-tar enamel

#### 2.2.4 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 or embossed 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 shall be installed as indicated on the drawings.

##### 3.1.2 Test Stations

Test stations shall be of the type and location shown and shall be curb box mounted. Buried electrically insulating joints shall be provided with test wire connections brought to a test station.

#### 3.2 CRITERIA OF PROTECTION

Criteria for determining the adequacy of protection on a buried isolated structure 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 structure and a saturated copper-copper sulfate reference electrode contacting the earth directly over the structure. 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 structure and a saturated copper-copper sulfate reference electrode contacting the earth directly over the structure. Determination of this voltage shift shall be made with the protective current applied. These

criteria apply to metallic structure 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 structure and a saturated copper-copper sulfate reference electrode contacting the earth directly over the structure. 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.

## 3.3 TESTS AND MEASUREMENTS

### 3.3.1 Baseline Potentials

After backfill of the structure and anodes is completed, but before the anodes are connected to the structure, the static potential-to-soil of the structure shall be measured. The locations of these measurements shall be identical to the locations specified for structure-to-reference electrode potential measurements. The initial measurements shall be recorded.

### 3.3.2 Anode Output

As the anodes or groups of anodes are connected to the structure, 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 Structure-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. (400 feet). 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.

3.3.6 Recording Measurements All structure-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 metallic structure encountered during checkout of the installed cathodic protection system. Structure-to-soil potential measurements are required on all underground protected structure.

END OF SECTION

## SECTION 16642

## CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)

## 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 53 (1990a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM D 1248 (1984; R 1989) Polyethylene Plastics Molding and Extrusion Materials

## MILITARY SPECIFICATIONS (MS)

MS MIL-I-1361 (Rev C; Notice 1) Instrument Auxiliaries, Electrical Measuring, Shunts, Resistors, and Transformers

## NACE INTERNATIONAL

NACE RP0169 (1983) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2 (1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NEMA WC 5 (1973; R 1985; Rev 1 thru 14) Thermoplastic-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 6 (Oct 23, 1981; 9th Ed; Rev thru Jul 8, 1991) Rigid Metal Conduit

UL 467 (Nov 22, 1984; 6th Ed; Rev thru Nov 14, 1986) Grounding and Bonding Equipment

UL 506 (Dec 22, 1989; 10th Ed; Rev Jan 1990) Specialty Transformers

UL 510 (Oct 6, 1986; 6th Ed; Rev Oct 7, 1986) Insulating Tape

UL 514A (Dec 27, 1991; 8th Ed) Metallic Outlet Boxes

## 1.2 Services of Corrosion Engineer

The Contractor shall obtain the services of a corrosion engineer to supervise and 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 NACE International 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.

### 1.3 Rules

The installation shall conform to the applicable rules of NFPA 70.

### 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 SUBMITTALS:

#### Data

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply.

#### Drawings

Cathodic Protection System; GA.

Detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, installation instructions and certified test data stating the maximum recommended anode current output density and the rate of gaseous production if any at that current density. 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.

#### Statements

Qualifications; FIO.

Evidence of qualifications of the corrosion engineer.

#### Reports

Tests and Measurements; FIO.

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system. Each test report shall indicate the final position of controls. A certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection, wherein the anode is subjected to maximum recommended current output while immersed in a 3 percent sodium chloride solution.

## Operation and Maintenance Manuals

Cathodic Protection System; GA.

Six copies of operating manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The manuals shall include diagrams for the system as installed, instructions in making tank-to-reference electrode measurements and frequency of monitoring.

## PART 2 PRODUCTS

## 2.1 IMPRESSED CURRENT ANODES

## 2.1.1 Bare High Silicon Cast-Iron Anodes

Cast-iron anodes shall be of the size indicated and shall conform to the following requirements:

## 2.1.1.1 Chemical Composition (Nominal)

<u>Element</u>	<u>Percent by Weight</u>	
	<u>Grade 1</u>	<u>Grade 2</u>
Silicon	14.20-14.75	14.20-14.75
Manganese	1.50 Max.	1.50 Max.
Carbon	0.70-1.10	0.75-1.15
Chromium	-----	3.25-5.00
Iron	Balance	Balance

## 2.1.1.2 Electrical Resistivity

Seven hundred twenty nanoohm-meter (Seventy-two microhm-centimeter) at 20 degrees F.

## 2.1.1.3 Physical Properties (Nominal)

Tensile strength	15,000 psi
Compressive strength	100,000 psi
Brinell hardness	520
Density	7.0 grams per cubic centimeter
Melting point	2300 degrees F
Coefficient of expansion from 32 to 212 degrees F	0.00000733 centimeter per degree F

## 2.1.2 Mixed Metal Oxide (Ceramic) Anodes

Ceramic anodes shall consist of a high purity titanium substrate coated with a conductive precious metal oxide. Ceramic anodes shall be ribbon type as indicated on the drawings.

## 2.1.3 Anode Connecting Cables

Anodes shall have connecting cables installed at the factory.

## 2.2 RECTIFIERS AND ASSOCIATED EQUIPMENT

### 2.2.1 Rectifier Unit

Rectifier unit shall consist of a transformer, rectifying elements, transformer tap adjuster, terminal block, one combination volt-ammeter, one toggle switch for each meter, fuse holders with fuses for each dc circuit, variable resistors, an ac power-supply circuit breaker, lightning arresters for both input and output, all wired and assembled in a weatherproof metal cabinet. The overall efficiency of the rectifier shall be not less than 65 percent when operated at nameplate rating and shall be capable of supplying continuous full rated output at an ambient temperature of 112 degrees F in full sunlight with expected life in excess of 10 years.

#### 2.2.1.1 Transformer

Transformer shall conform to UL 506.

#### 2.2.1.2 Rectifiers

Rectifying elements shall be selenium cells connected in such manner as to provide full-wave rectification.

#### 2.2.1.3 Meters

Meters shall be accurate to within plus or minus 2 percent of full scale at 80 degrees F, and shall possess temperature stability above and below 80 degrees F of at least 1 percent per 10 degrees F. Separate meters shall be 63.5 mm nominal size or larger.

#### 2.2.1.4 Circuit Breaker

A single-pole, flush-mounted, fully magnetic, properly rated nonterminal type circuit breaker shall be installed in the primary circuit of the rectifier supply transformer.

#### 2.2.1.5 Fuses

Cartridge-type fuses conforming with suitable fuse holders shall be provided in each leg of the dc circuit.

### 2.2.2 Cabinet Construction

Cabinet shall be constructed of not lighter than No. 16-gauge steel, and shall be provided with a full door. The door shall be hinged and have a hasp that will permit the use of a padlock. The cabinet shall be fitted with screened openings of the proper size to provide for adequate cooling. Holes, conduit knockouts, or threaded hubs of sufficient size and number shall be conveniently located.

#### 2.2.2.1 Wiring Diagram

A complete wiring diagram of the power unit showing both the ac supply and the dc connections to anodes shall be on the inside of the cabinet door. All components shall be shown and labeled.

#### 2.2.2.2 Grounding Provisions

Grounding provisions shall comply with NFPA 70 and UL 467 including a grounding terminal in the cabinet. The grounding conductor from the terminal to the earth

grounding system shall be solid or stranded copper not smaller than No. 6 AWG. The earth grounding system shall consist of one or more 19 mm diameter copper-clad steel rods. Ground rods shall be 3048 mm long minimum.

#### 2.2.2.3 Cabinet Paint System

The cabinet and supporting mounting shall be painted with the manufacturer's standard paint system.

#### 2.2.3 Wiring

Wiring shall be installed in accordance with NFPA 70 utilizing type TW or RHW or polyethylene insulation. Fittings for conduit and cable work shall conform to UL 514A. Outlets shall be of the threaded hub type with gasketed covers. Conduit shall be of the threaded hub type with gasketed covers. Conduit shall be securely fastened at 2438 mm intervals or less. Splices shall be made in outlet fittings only. Conductors shall be color coded for identification.

### 2.3 COKE BREEZE

#### 2.3.1 Calcined Petroleum Coke Breeze (Dry)

Breeze shall conform to the following requirements:

##### 2.3.1.1 Electrical Resistivity

10 milliohm-meter to 20 milliohm-meter -(1.0 to 2.0 ohm-centimeter - ) tightly compacted  
100 milliohm-meter to 150 milliohm-meter -(10 to 15 ohm-centimeter - ) loosely compacted

##### 2.3.1.2 Bulk Density

Seventy-one to one hundred ten kilograms per cubic meter (Forty-eight to seventy-four pounds per cubic foot).

#### 2.3.2 Metallurgical Coke Breeze (Processed)

Breeze shall conform to the following requirements:

##### 2.3.2.1 Electrical Resistivity (Nominal)

100 milliohm-meter (10 ohm-centimeter) - Max., tightly compacted  
100 milliohm-meter to 150 milliohm-meter (10 to 15 ohm-centimeter) - lightly compacted  
150 to 200 milliohm-meter (15 to 20 ohm-centimeter) - loose

##### 2.3.2.2 Bulk Density

Fifty-six to sixty-three kilograms per cubic meter (Thirty-eight to forty-two pounds per cubic foot.)

### 2.4 MISCELLANEOUS MATERIALS

#### 2.4.1 Electrical Wire

##### 2.4.1.1 Anode Connecting Wire

Anode connecting wire shall be No. 8 AWG stranded copper wire with type CP high molecular weight polyethylene insulation, 0.2778 mm thick, 600 volt rating, in accordance with NEMA WC 5. Cable-to-anode contact resistance shall be 0.003 ohms maximum.

#### 2.4.1.2 Anode Header Cable

Cable for anode header and distribution shall be No. 8 AWG stranded copper wire with type CP high molecular weight polyethylene, 0.2778 mm thick insulation, 600-volt rating, in accordance with NEMA WC 5.

#### 2.4.1.3 Test Wires

Test wires shall be AWG No. 12 stranded copper wire with NFPA 70 Type TW or RHW or polyethylene insulation.

#### 2.4.1.4 Resistance Wire

#### 2.4.2 Conduit

Rigid galvanized steel conduit and accessories shall conform to UL 6. Nonmetallic conduit shall conform to NEMA TC 2.

#### 2.4.3 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

#### 2.4.4 Polyethylene Insulation

Polyethylene insulation shall comply with the requirements of ASTM D 1248 and of the following types, classes, and grades:

##### 2.4.4.1 High Molecular Weight Polyethylene

High molecular weight polyethylene shall be Type I, Class C, Grade E5.

#### 2.4.5 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 or embossed legend, "C.P. Test".

#### 2.4.6 Calibrated Shunts

Shunts shall conform to MS MIL-I-1361.

#### 2.4.7 Joint, Patch, Seal, and Repair Coating

##### 2.4.7.1 Sealing and Dielectric Compound

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 0.3175 mm thick.

##### 2.4.7.2 Coating Compound

Coating compound shall be hot-applied coal-tar enamel.

##### 2.4.7.3 Preformed Sheaths

Preformed sheaths for encapsulating electrical wire splices to be buried underground shall fit the insulated wires entering the spliced joint.

##### 2.4.7.4 Epoxy Potting Compound

Epoxy potting compound for encapsulating electrical wire splices to be buried underground shall be a two package system made for the purpose.

#### 2.4.7.5 Backfill Shields

Backfill shields shall consist of approved pipeline wrapping or fiberglass reinforced, coal-tar impregnated tape, or plastic weld caps, specifically made for the purpose.

#### 2.4.7.6 Electrical Tape

Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

#### 2.4.8 Electrically Insulating Pipe Joints

Electrically insulating pipe joints for above or below ground use shall be flexible, mechanical pipe couplings of an electrically insulating type consisting of bolted or compression design provided with electrically insulating joint harness if required to provide pull-out strength.

##### 2.4.8.1 Threaded Fittings

Threaded type electrically insulating pipe joints shall have molded plastic screw threads and be used above ground only. Machined plastic screw threads shall not be used.

##### 2.4.8.2 Electrically Insulating Pipe Joints

Electrically insulating pipe joints shall be of a type that is in regular factory production.

#### 2.4.9 Electrically Conductive Couplings

Electrically conductive couplings shall be of a type that has a published maximum electrical resistance rating given in the manufacturer's literature. Cradles and seals shall be of a type that is in regular factory production made for the purpose of electrically insulating the carrier pipe from the casing and preventing the incursion of water into the annular space.

### PART 3 EXECUTION

#### 3.1 CRITERIA OF PROTECTION

Criteria for determining the adequacy of protection on a buried pipe and tank shall be in accordance with NACE RP0169 and shall be selected by the corrosion engineer as applicable.

##### 3.1.1 Iron and Steel

One of the following methods shall apply:

a. A negative voltage of at least minus 0.85 volts as measured between the pipe or tank and a saturated copper-copper sulphate reference electrode contacting the earth directly over the pipe or tank. Determination of this voltage shall be made with the cathodic protection system in operation.

b. A negative voltage shift of at least 300 millivolts as measured between the pipe or tank and a saturated copper-copper sulphate reference electrode contacting the earth directly over the pipe or tank. Determination of this voltage shift shall be made with the protective current applied. These

criteria apply to pipes or tanks not in electrical contact with dissimilar metals.

## 3.2 GROUND BED INSTALLATION

### 3.2.1 Shallow Ground Beds

Shallow ground beds shall contain size and quantity of anodes designed to meet performance criteria of the cathodic protection system at an initial operating current output density not exceeding 40 percent of maximum recommended current

#### 3.2.1.1 Vertically Buried Canister-Contained Anodes

Vertically buried canister-contained anodes shall be installed in vertical holes in the ground having depth, spacing, and locations shown. The holes in the ground shall be sufficiently larger in diameter than the canisters to facilitate easy lowering into the hole and backfilling. The space between the canister and the wall of the hole shall be completely backfilled with a wet slurry of earth free of stones.

#### 3.2.1.2 Cable Protection

Positive cable to the ground bed and negative cable to the pipe or tank to be protected shall be buried a minimum depth of 610 mm except where above ground construction utilizing conduit is used.

#### 3.2.1.3 Multiple Anode Systems

Multiple anode systems shall consist of groups of anodes connected in parallel to a header cable, buried in the ground at depths, spacing, and locations shown. The anodes shall be buried vertically.

#### 3.2.1.4 Distributed Anode Systems

Distributed anode systems shall consist of a line or row of anodes connected in parallel to a header cable and buried in the ground parallel to the pipeline. The anodes shall be at the pipeline at depths, spacing, and locations shown. The anodes shall be buried vertically.

## 3.3 MISCELLANEOUS INSTALLATION

### 3.1 Rectifier Installation

Mounting shall be as shown. Pole or wall mounting shall be equipped with a channel bracket, lifting eyes, and a keyhole at the top

### 3.3.2 Wire Connections

#### 3.3.2.1 Wire Splicing

Connecting wire splicing shall be made with copper compression connectors or exothermic welds, following instructions of the manufacturer. Split-bolt type connectors shall not be used.

#### 3.3.2.2 Steel Surfaces

Connections to ferrous pipe or metal tanks shall be made by exothermic weld methods as manufactured by an approved manufacturer for the type of pipe or tank. Electric arc welded connections and other types of welded connections to ferrous pipe and structures shall be approved before use.

### 3.3.3 Pipe Joints

#### 3.3.3.1 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 the following electrical continuity requirements:

a. 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.

b. Mechanical joints designed to provide electrical continuity may be used.

#### 3.3.3.2 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.

a. 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.

b. Couplings and fittings that cannot be properly taped shall be enclosed in a spaced mold manufactured for the purpose hot applied bituminous compound not exceeding 275 degrees F in application temperature.

#### 3.3.3.3 Electrical Isolation of Structures

Electrical isolation of structures shall be as follows:

a. 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 surge arresters, grounding cells, or other means. Insulating flanges and couplings in lines entering buildings shall be located at least 305 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 wall sleeve.

b. 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.

c. Line Supply and Return Piping: Electrical isolation shall be provided at each building entrance, and at other locations as indicated.

d. Fuel Tanks: Electrical isolation shall be provided in each pipe as shown.

#### 3.4 Dissimilar Metals

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 pipes, shall be coated with an underground type dielectric coating for a minimum distance of 10 diameters on each side of the joint.

##### 3.4.1 Ferrous 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.

#### 3.4.2 Brass or Bronze Valves

Brass or bronze valves shall not be used in a buried ferrous pipeline.

#### 3.4.3 Metal Pipe Junction

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 3 diameters on each side of the junction.

#### 3.4.4 Casing

Where a pipeline is installed in a casing under a roadway or railway, the pipeline shall be electrically insulated from the casing, and the annular space sealed against incursion of water.

### 3.5 TESTS AND MEASUREMENTS

#### 3.5.1 Test Stations

3.5.2 Test stations shall be of the type and location shown. Buried electrically insulating joints shall be provided with test wire connections brought to a test station. Changes in designated location must have prior approval. Unless otherwise shown, other test stations shall be located as follows:

- a. At 304 800 mm (1,000-foot) 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 ends of an insulating joint are not accessible aboveground for testing purposes.
- e. As shown.

#### 3.5.3 Baseline Potentials

After backfill of the pipe or tank and anodes is completed, but before the anodes are connected to the pipe or tank, the static potential-to-soil of the pipe or tank shall be measured. The locations of these measurements shall be identical to the locations specified for pipe- or tank- to-reference electrode potential measurements. The initial measurements shall be recorded.

#### 3.5.4 Insulation Testing

Before the anode system is connected to the pipe or 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 or tank. Any insulating fittings installed and found to be defective shall be reported to the Contracting Officer.

#### 3.5.5 Anode Output

As the anodes or groups of anodes are connected to the pipe or tank, current output shall be measured with an approved low resistance ammeter. The values obtained and the date, time, and locations shall be recorded.

### 3.5.6 Pipe- or 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 sulphate 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 one or two volts. The locations of these measurements shall be identical to the locations used for baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded.

### 3.5.7 Location of Measurements

#### 3.5.7.1 Coated 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 121 920 mm (400 feet). 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.

### 3.5.8 Casing Tests

Before final acceptance of the installation, the electrical separation of carrier pipe from casings shall be tested and any short circuits corrected at no expense to the Government.

### 3.5.9 Interference Testing

Before final acceptance of the installation, interference tests shall be made with respect to any foreign pipes or tanks in cooperation with the owner of the foreign pipes or tanks. A full report of the tests giving all details shall be made.

### 3.5.10 Recording Measurements

All pipe- or tank- to-soil potential measurements including initial potentials where required shall be recorded. The Contractor shall locate, correct and report to Contracting Officer any short circuits to foreign pipes or tanks encountered during checkout of the installed cathodic protection system. Pipe- or Tank- to-soil potential measurements are required on as many pipes or tanks as necessary to determine the extent of protection or to locate short-circuits.

## 3.6 TRAINING COURSE

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 field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

END OF SECTION



## SECTION 16665

## STATIC ELECTRICITY PROTECTION SYSTEM

## PART 1 GENERAL

1.1 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 C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 77 (1988) Static Electricity

NFPA 99 (1990) Health Care Facilities

## UNDERWRITERS LABORATORIES (UL)

UL 467 (Nov 22, 1984; 6th Ed; Rev thru Nov 14, 1986) Grounding and Bonding Equipment

## 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 SUBMITTALS:

Drawings Protection System; FIO.

Detail drawings consisting of a complete list of equipment and material, manufacturer's descriptive and technical literature, catalog cuts, wiring diagrams, and installation instructions. Drawings shall demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts.

Reports Testing and Inspection; FIO.

Test data in booklet form, upon completion of installation of the system. The test report shall document all field tests performed and shall verify compliance with the specified performance criteria. Test data shall include the make, model and serial number of instruments used to conduct the test, and a certificate from an approved independent testing laboratory of meter calibration performed within 12 months of test.

## 1.3 GENERAL REQUIREMENTS

### 1.3.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work. No departures shall be made without the prior approval of the Contracting Officer.

### 1.3.2 Rules

The installation shall conform to the applicable rules of NFPA 70.

## PART 2 PRODUCTS

### 2.1 MATERIAL AND EQUIPMENT

#### 2.1.1 General Requirements

Materials shall comply with the requirements of NFPA 77 and UL 467. No combination of materials shall be used that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause deterioration of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate therefor, or the conductors may be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

#### 2.1.2 Bonding Conductors

Conductors shall be of the uninsulated type. Conductor size shall be No. 6 AWG copper. Flexible or strap type copper conductors, with a thickness not less than No. 12 AWG and an electrical and mechanical equivalence of not less than No. 6 AWG, shall be used for bonding between moveable objects and connections which are disconnected frequently.

#### 2.1.3 Ground Rods (Electrodes)

Ground rods shall be of copper-clad steel, conforming to UL 467 not less than 19 mm in diameter by 3048 mm in length.

#### 2.1.4 Static Ground Receptacles

Receptacles shall contain ground connection stud, housing cover and ground rod. Ground rods shall be interconnected below pavement or floor and connected to electrical service ground system via No. 4 AWG bare copper conductor.

## PART 3 EXECUTION

### 3.1 INSTALLATION

The installation shall conform to the manufacturer's recommendations, except where otherwise specified.

### 3.1.1 Static Grounding

Grounding conductors for static ground receptacles, conductive floors and equipment installed on conductive floors shall be connected to ground rods and interconnected as indicated. The static grounding system shall be connected below grade to the electrical power grounding system and any lightning-protection grounding system.

### 3.1.2 Ground Rods

Ground rods shall be installed vertically in the earth until tops of rods are

### 3.1.4 Grounding of Electrical Equipment

Electrical equipment shall be grounded as specified in Section 16415 ELECTRICAL WORK, INTERIOR.

## 3.2 TESTING AND INSPECTION

### 3.2.1 Ground Resistance Testing

#### 3.2.1.1 Ground Resistance Meter

Ground resistance shall be measured with bridge-type meter designed for testing grounds.

#### 3.2.1.2 Information Recorded

Soil conditions, weather, model and serial number of meter, date, and name of tester shall be recorded along with the resistance-to-ground readings of the protected equipment.

#### 3.2.1.3 Notification

Tests shall be conducted in the presence of the Contracting Officer or his authorized representative. The Contracting Officer shall be notified 30 days before the performance and acceptance tests are to be conducted.

#### 3.2.1.4 Facilities Storing Flammable or Explosive Liquids, Gases

The static electricity protection system will be deemed unsatisfactory if the resistance to ground exceeds 25 ohms.

#### 3.2.1.5 System Inspection

Conducting components, with the exception of grounding rods, shall not be concealed until inspected and accepted by the Contracting Officer.

END OF SECTION

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## SECTION 16721

## FIRE DETECTION AND ALARM 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 C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825 (1994) Approval Guide

## FEDERAL STANDARDS (FED-STD)

FED-STD 595 (Rev B) Colors Used in Government Procurement

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 72 (1996) National Fire Alarm Code

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

## UNDERWRITERS LABORATORIES (UL)

UL-04 (1994) Fire Protection Equipment Directory

UL 6 (1993) Rigid Metal Conduit

UL 38 (1994; Rev Jan 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 228 (1993) Door Closers-Holders, with or without Integral Smoke Detectors

UL 268	(1989; Rev May 1989) Smoke Detectors for Fire Protective Signaling Systems
UL 464	(1990) Audible Signal Appliances
UL 467	(1993) Grounding and Bonding Equipment
UL 521	(1993) Heat Detectors for Fire Protective Signaling Systems
UL 797	(1993) Electrical Metallic Tubing
UL 864	(1991; Rev thru Jun 1993) Control Units for Fire-Protective Signaling Systems
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours.

### 1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

### 1.2.3 Keys and Locks

Locks shall be keyed alike.

### 1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

### 1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

### 1.2.6 Compliance

The fire detection and internal alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a

nationally recognized testing laboratory in accordance with the applicable NFPA standards.

#### 1.2.7 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, testing, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

### 1.3 SYSTEM DESIGN

#### 1.3.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, in accordance with NFPA 72. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC), Style X or 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, or IAC 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

- a. Electrical supervision of alarm IDC and IAC.
- b. Electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.
- c. Trouble buzzer and trouble lamp (light emitting diode or neon light) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.
- d. Transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but shall provide a trouble signal when disconnected and a restoration signal when reconnected.
- e. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the alarm devices will be activated.
- f. Electrical supervision of circuits used for supervisory signal services. Supervision shall detect any open, short, or ground.

g. Zones for alarm IDC shall be arranged as indicated on the contract drawings.

### 1.3.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of a signal over the station radio fire reporting system. The signal shall be common for all zones.

b. Visual indications of the alarmed zone on the fire alarm control panel annunciator.

c. Continuous sounding of alarm notification appliances throughout the building.

### 1.3.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

### 1.3.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

## 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 SUBMITTALS:

#### Data

Battery; FIO.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop; FIO.

Voltage drop calculations for signaling appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, not later than 2 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

### Drawings

Fire Alarm Reporting System; GA.

Detail drawings, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram, showing all points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and all equipment that is activated or controlled by the panel.

### Instructions

Fire Alarm Reporting System; GA.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Instructions shall be approved prior to training.

Training; FIO

Lesson plans and training data, in manual format, for the training courses.

### Statements

Test Procedures; FIO.

Detailed test procedures for the fire detection and alarm system 60 days prior to performing system tests.

### Reports

Testing; FIO.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document all readings, test results and indicate the final position of controls.

### Certificates

Equipment; FIO.

Certified copies of current approvals or listings issued by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Installer; FIO.

The Contractor shall provide documentation demonstrating that its fire detection and alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this contract. Such documentation shall specifically include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. All such data shall be submitted 30 days prior to commencement of installation for approval of the Contracting Officer. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" of UL-04 shall be accepted as equivalent proof of compliance with the foregoing experience requirements.

#### 1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

### PART 2 PRODUCTS

#### 2.1 CONTROL PANEL

Control Panel shall comply with all the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing all components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for all lamps, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm located on exterior of cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any or all batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciators shall be provided for each active zone and spare zone. **Two** spare zones shall be provided. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic, phenolic or metal sign with either raised or engraved letters. Zone identification shall consist of word description of the zone. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate

all units. All shall be painted red similar to FED-STD 595 color, number 11105.

#### 2.1.1 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.

#### 2.2 STORAGE BATTERIES

Storage Batteries shall be provided and shall be the sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours based on a 48 hour discharged rate than required for the calculated capacities. Battery cabinet shall be a separate binet. Battery shall be provided with overcurrent protection in accordance with NFPA 72.

#### 2.3 BATTERY CHARGER

Battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 24 hours. A separate ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly if a high rate switch is provided. Charger shall be located in control panel or battery cabinet.

#### 2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm-initiating circuits. Stations shall be installed on surface mounted outlet boxes. Stations shall be singleaction type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be painted the same color as the fire alarm manual stations.

#### 2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator lamp. Installed devices shall conform to the classification of the area.

### 2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by fixed temperature or combination fixed temperature and rate-of-rise principle. Heat detectors shall be rated for a minimum of 15 240 mm (50 foot) spacing (smooth-ceiling rated) in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

#### 2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. Rating for fixed temperature portion shall be 135 degrees Fahrenheit temperature conditioned spaces.

#### 2.5.1.2 Fixed Temperature Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Detectors are designed to detect high heat. The detectors shall have a specific temperature setting of 200 degrees Fahrenheit.

### 2.5.2 Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator lamp that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making in which the detector base contains terminals for making all wiring connections. Detectors that are in concealed (above false ceilings, etc.) locations shall have a remote visible indicator lamp.

#### 2.5.2.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating between 1.9 and 2.4 percent per foot when tested in accordance with UL 268.

## 2.6 NOTIFICATION APPLIANCES

Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits. All devices shall have a separate screw terminal for each conductor. All shall be painted red similar to FED-STD 595 color, number 11105.

### 2.6.1 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mounted vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a minimum sound rating of at least 92 dBA at 3 048 mm. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grills.

### 2.6.2 Visual Notification Appliances

Visual notification appliances shall have high intensity optic lens and flash tubes. Strobes shall flash at approximately 1 flash per second and a minimum of 1 candela (8,000 peak candle power). Strobe shall be surface mounted.

### 2.6.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. All units shall be factory assembled. Any other audible indicating appliance employed in the fire alarm systems shall be approved by the authority having jurisdiction.

## 2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

Ground rods shall be of copper clad steel conforming to UL 467 not less than 19 mm in diameter by 3048 mm.

### 2.7.2 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

### 2.7.3 Wiring

Wiring for 120V ac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. All conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, supervisory circuits, and alarm indicating circuits are prohibited.

### 2.7.4 Special Tools and Spare Parts

Special tools necessary for the maintenance of the equipment shall be furnished. Two spare fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

## 2.8 TRANSCEIVER

### 2.8.1 General

Transceiver shall be a Monaco BT2-7. (Monaco Enterprises Inc., E. 14820 Sprague Avenue, P.O. Box 14129, Spokane Washington 509-926-6277). Transmitter shall be complete with associated equipment including interface and antenna.

### 2.8.2 Transceiver

The transceiver shall transmit at 138.925 Mhz. The transceiver shall be solid state and include an integral power supply, charger, and sealed batteries.

### 2.8.3 Storage Batteries

Storage Batteries shall be provided and shall be the sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the transmitter for a period of 48 hours. Battery cabinet shall be a separate compartment within the control panel. Batteries in the transmitter panel shall be located at the bottom of the panel. Battery shall be provided with overcurrent protection in accordance with NFPA 72.

### 2.8.4 Battery Charger

Battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 24 hours. Charger shall be located in control panel or battery cabinet.

### 2.8.5 Interface

The interface shall consist of all equipment necessary to connect the transmitter to the fire alarm control unit so fire alarm and trouble signals will be appropriately transmitted.

### 2.8.6 Antenna

Transmitter shall have its own antenna. Antenna shall be of suitable strength to withstand ice and 125 mph wind load. Antenna shall be stainless steel and shall be located well away from overhead power circuits. Antenna shall be a 6 element directional Yagi. Mounting brackets and bracing shall be of a configuration appropriate to the structure on which the antenna is mounted. Antenna shall be mounted on the exterior of the facility. The radial ground plane elements shall be not less than 610 mm from grounded metal surfaces. Antenna discharge unit shall be grounded in accordance with NFPA 72.

## PART 3 EXECUTION

### 3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified.

#### 3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power to each building fire alarm system shall be provided. The primary power shall be supplied as

shown on the drawings. The power supply shall be equipped with a locking mechanism and marked "FIRE ALARM CIRCUIT CONTROL".

### 3.1.2 Wiring

Wiring for systems shall be installed in 21 mm minimum diameter conduit. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors are prohibited in the system. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

### 3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 305 mm nor more than 1981 mm above the finished floor. All manually operable controls shall be between 914 mm to 1067 mm above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

### 3.1.4 Detectors

Detectors shall be installed in accordance with NFPA 72. Detectors shall be at least 305 mm from any part of any lighting fixture. Detectors shall be located at least 914 mm from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 914 mm, sway bracing shall be provided.

### 3.1.5 Notification Appliances

Notification appliances shall be mounted a minimum of 2438 mm above the finished floor unless limited by ceiling height or otherwise indicated.

### 3.1.6 Annunciator Equipment

Annunciator equipment provided shall be mounted where indicated.

## 3.2 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

### 3.3 GROUNDING

Grounding shall be provided to building ground or ground rods shall be driven. Maximum impedance to ground shall be 25 ohms. Ground rods shall not protrude above grade.

### 3.4 TESTING

The Contractor shall notify the Contracting Officer 30 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise all tests. The Contractor shall furnish all instruments and personnel required for the tests.

#### 3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional.

#### 3.4.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The test shall include the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of all wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage

m. Loop resistance

### 3.5 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period shall consist of **1** training day (2 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover all of the items contained in the operating and maintenance instructions.

END OF SECTION



## SECTION 16742

## TELEPHONE 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.

- FEDERAL COMMUNICATIONS COMMISSION (FCC)  
FCC Part 68 (Jul 1986) Rules and Regulations: Connection of Terminal Equipment to the Telephone Network
- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)  
NEMA TC 2 (1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)  
NEMA TC 13 (1986) Electrical Nonmetallic Tubing (ENT)
- NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)  
NFPA 70 (1996) National Electrical Code  
NFPA 101 (1997) Life Safety Code
- ELECTRONIC INDUSTRIES ASSOCIATION (EIA)  
EIA/TIA 568A (1991) Commercial Building Telecommunications Wiring Standard  
EIA/TIA 569 (1990) Commercial Building Standard for Telecommunications Pathways and Spaces  
EIA/TIA 606 (1993) Administration Standard for the telecommunications Infrastructure of Commercial Buildings  
EIA/TIA TBS 36 (1991) Technical Systems Bulletin Additional Cable Specifications for Unshielded Twisted Pair Cables  
EIA/TIA TBS 40 (1992) Additional Transmission Specifications for Unshielded Twisted Pair Connecting Hardware
- UNDERWRITERS LABORATORIES (UL)  
UL-03 (1990; Supple) Electrical Construction Materials Directory  
UL 5 (May 28, 1985; 10th Ed) Surface Metal Raceways and Fittings  
UL 6 (Oct 23, 1981; 9th Ed; Rev thru Nov 22, 1989) Rigid Metal Conduit  
UL 497 (Dec 15, 1978; 4th Ed; Rev thru Oct 9, 1984) protectors for Communications Circuits

UL 510	(Oct 6, 1986; 6th Ed; Rev Oct 7, 1986) Insulating Tape
UL 651	3, 1989; 5th Ed; Rev thru Dec 4, 1989) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(Aug 10, 1989; 2nd Ed; Rev Aug 11, 1989) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 797	(Oct 10, 1983; 5th Ed) Electrical Metallic Tubing
UL 1242	(Oct 10, 1983; 1st Ed; Rev Nov 23, 1989) Intermediate Metal Conduit

## 1.2 GENERAL

### 1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated herein or shown.

### 1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible.

### 1.2.3 Standard Products

Materials and equipment shall be a 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.

### 1.2.4 As Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as built drawings to the Contracting Officer.

## 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 SUBMITTALS.

### Drawings

Electrical Work; FIO.

Detail drawings for all materials and equipment specified. Detail drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required. Drawings shall show applicable schematic diagrams and equipment layout and anchorage. Telephone system drawings showing actual layout, including locations, type any gasuge of cables, and terminal assignment of wiring, after installation.

### Reports

Materials and Equipment; FIO.

The label or listing of the Underwriters Laboratories, Inc., shall be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. materials and equipment shall be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

#### Certificates

Telephone Installer; FIO.

Qualifications of the telephone installer.

#### 1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

#### 1.5 MANUALS

##### 1.5.1 Hardware Manual

A manual describing all equipment furnished, including:

- a. General description and specifications.
- b. Installation and checkout procedures
- c. Equipment electrical schematics and layout drawings
- d. Data transmission systems schematics.
- e. Alignment and calibration procedures.
- f. Manufacturer's repair parts list including sources of supply.
- g. Interface definition.

##### 1.5.2 Operator's Manual

The operator's manual shall fully explain all procedures and instructions for operation of the system.

##### 1.5.3 Maintenance Manual

The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section.

## 2.2 Conduit and Tubing

### 2.2.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797.

### 2.2.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

### 2.2.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

### 2.2.4 Innerduct

SIDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

## 2.3 Telephone Cables, EIA/TIA 568-569, PE-39.

## 2.4 Connector Blocks.

Connector blocks shall be type 66 equipped with punch down clips.

## 2.5 Telephone Backboards.

Backboards shall be 1219 mm x 2438 mm x 1.59 mm ACX plywood having a two-coat insulating varnish finish.

## 2.6 Protector Modules

The protector modules shall be of the three-electrode gas tube type and service rated. The gas modules shall be fail-short and shall shunt high voltage to ground in less than 10 nanoseconds, shall have an external spark gap, and shall comply with UL 497.

## 2.7 Ground Rods.

Ground rods shall be required in SECTION: ELECTRICAL WORK, INTERIOR.

## 2.8 Telephone Jacks.

FCC Part 68, plastic shall be class VO in accordance with UL 94.

## 2.9 Telephone Instruments.

Telephone instruments will be provided and installed by the 1115th Signal Battalion.

## PART 3 EXECUTION

### 3.1 Raceways

#### 3.1.1 Communications Raceways.

Communications raceways indicated shall be installed as required in SECTIONS: 16415 ELECTRICAL WORK, INTERIOR and 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

#### 3.1.2 Innerduct.

Four innerducts shall be provided in each 102 mm conduit indicated. Innerduct shall be pulled through existing and new 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. Duct seal shall be placed between the innerduct and the duct. In those innerducts in which cables are placed, duct seal shall be placed between the cable and the innerduct. Not more than 1 cable shall be installed in any innerduct. Unoccupied innerducts shall be trimmed leaving 51 mm exposed.

### 3.2 TELEPHONE WIRING SYSTEM

The telephone wiring system shall be complete and functional.

#### 3.2.1 Telephone Cables

Each telephone outlet will be serviced with 24-gauge solid copper station-type color coded cable, vinyl insulated with an overall vinyl jacket. Cable shall be continuous from each telephone outlet to the backboard indicated on the drawings. Splicing of individual cables shall not be permitted. At each outlet, four-pair cable shall be terminated on the modular jack assembly, using color code provided by the Contracting Officer. At the backboard, cables shall be terminated on cross-connect terminal blocks and marked with the appropriate outlet number. Cable and connecting hardware shall be installed in accordance with the manufacturers guidelines to achieve transmission capabilities of EIA/TIA TBS 36 & 40. The maximum pulling tension for 4-pair 24 AWG horizontal unshielded twisted pair (UTP) cable shall not exceed 25 lbs. Cable bend radii shall not be less than 10-times the cable diameter for multipair cable. Care shall be exercised to avoid twisting cable during installation or untwisting individual pairs more than necessary. Cables designated as "Data" shall be terminated in the Equipment Room using 110 type, Category 5 patch panels.

#### 3.2.1 Modular Jacks

Modular jacks shall comply with FCC Rules and Regulations, Part 68, Subpart F. Each modular jack shall be a 6 or 8-position jack as indicated with 110 type quick connect terminals for connecting cables.

#### 3.2.2 Telephone Outlets

Outlets shall consist of 4x4 device boxes with 2x4 plaster rings and cover plates with 4 modular jacks. Each outlet shall have 2 6-pin (RJ-11) modular jacks and 2 8-pin (RJ-45) modular jacks. Each outlet shall have a category 3 4-pair telephone cable for voice and 2 4-pair category 5, brightly colored, telephone cable for data. Modular jacks shall be individually marked for "voice" and "data" application. Each outlet shall be numbered for easy identification and location.

#### 3.2.3 Modular Jack Patch Panel

Modular jack patch panel shall be wall mount panel with 110 type, category 5, 8-pin (RJ-45) modular telephone jacks.

#### 3.2.4 Telephone Backboards

Telephone backboards shall be installed at location shown on the drawings.

#### 3.2.5 Building Entry Protection Modules

Building Entry Protection Service Rated Modules shall be provided to terminate the building feeder cable. The modules shall be attached to the left side of the telephone backboard.

### 3.3 Auxiliary Devices

All auxiliary devices such as tie bars, cable rings, etc. which are not shown but are required for installation shall be provided.

### 3.4 Qualifications of Installer

The system shall be installed by an experienced installer regularly engaged in the installation of telephone systems. The Contracting Officer may reject any proposed installer who can not show evidence of such qualifications.

### 3.5 GROUNDING

Grounding conductor shall be connected to the secondary grounding electrode system.

### 3.6 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

### 3.7 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

### 3.8 TESTS

Acceptance tests shall be developed by the Contractor. The Contractor shall notify the Contracting Officer 5 days before the acceptance tests are to be conducted. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests. The Contractor shall record all test data and shall furnish a record copy to the Contracting Officer.

#### 3.8.1 Copper Telephone Cable

Interior and exterior cables shall be tested to verify that installed cables are free from shorts, crosses, opens, grounds, and splits, and that the integrity of the insulation has been maintained and to verify that transmission characteristics and minimum performances of interior cables for category 5 described by EIA/TIA Telecommunications System Bulletins (TBS) 36 and 40 are met. Testing shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests.

### 3.9 COMMUNICATIONS INSTALLATION PRECEDENCE

To prevent an unscheduled phone outage, new direct buried communications line south of the construction site (see sheet E-2) must be completed and accepted by the Government prior to breaking ground for site work by other disciplines

END OF SECTION

## SECTION 16768

## FIBER OPTIC DATA TRANSMISSION 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 C2 (1993) National Electrical Safety Code

## CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 310-D (1992) Cabinets, Racks, Panels, and Associated Equipment

EIA 455-13 (1984; R 1990) FOTP-13 Visual and Mechanical Inspection of Fibers Cables, Connectors and/or Other Fiber Optic Devices

EIA 455-25A (1989) FOTP-25 Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies

EIA 455-41 (1985) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables

EIA 455-46A (1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers

EIA 455-47B (1992) FOTP-47 Output Far-Field Radiation Pattern Measurement

EIA 455-58A (1990) FOTP-58 Core Diameter Measurement of Graded-Index Optical Fibers

EIA 455-59 (1989) FOTP-59 Measurement of Fiber Point Defects Using an OTDR

EIA 455-61 (1989) FOTP-61 Measurement of Fiber or Cable Attenuation Using an OTDR

EIA 455-65 (1988) FOTP-65 Optical Fiber Flexure Test

EIA 455-81A (1991) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable

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- EIA 455-88 (1987) FOTP-88 Fiber Optic Cable Bend Test
- EIA 455-91 (1986; R 1991) FOTP-91 Fiber Optic Cable Twist-Bend Test
- EIA 455-104A (1993) FOTP-104 Fiber Optic Cable Cyclic Flexing Test
- EIA 455-170 (1989) FOTP-170 Cable Cutoff Wavelength of Single-Mode Fiber by Transmitted Power
- EIA 455-171 (1987) FOTP-171 Attenuation by Substitution Measurement - for Short-Length Multimode Graded-Index and Single-Mode Optical Fiber Cable Assemblies
- EIA 455-177A (1992) FOTP-177 Numerical Aperture Measurement of Graded-Index Optical Fibers
- EIA 485 (1983) Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems
- EIA 606 (1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

INTERNATIONAL TELECOMMUNICATIONS UNION

- G.703 (1991) Physical/Electrical Characteristics of Hierarchical Digital Interfaces
- G.921 (1988) Digital Sections Based on the 2048 kbit/s Hierarchy

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA 250 (1991) Enclosures for Electrical Equipment (1000 volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

- UL 1449 (1996) Transient Voltage Surge Suppressors

1.2 SYSTEM DESCRIPTION

1.2.1 General

A fiber optics (FO) FT3 (OC3) telecommunications system shall be provided. The telecommunications system shall consist of fiber optic transmission media, FO multiplexers/demultiplexers, channel banks, power line surge protection and terminal devices (such as connectors, patch panels and breakout boxes). The telecommunications system shall interconnect system components as shown. Computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class B computing devices and labeled as set forth in 47 CFR 15.

#### 1.2.2 Environmental Requirements

Equipment and cable to be utilized indoors shall be rated for continuous operation under ambient environmental conditions of -40 to 65 degrees C (-40 to 149 degrees F) dry bulb and 10 to 95 percent relative humidity, noncondensing. Equipment shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location. Fiber optic cable for outdoor installation shall be rated for minus 40 to plus 60 degrees C (minus 40 to plus 122 degrees F).

#### 1.2.4 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.

#### 1.2.5 Input Line Surge Protection

Inputs and outputs shall be protected against surges induced on wiring including wiring installed outdoors. Communications equipment shall be protected against surges induced on any communications circuit. Cables and conductors (except fiber optics which serve as communications circuits from consoles to field equipment) and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 1 meter (3 feet) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

#### 1.2.6 Power Line Surge Protection

Equipment connected to ac circuits shall be protected from power line surges. Equipment shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

### 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 01330 SUBMITTAL PROCEDURES:

#### Data

Fiber Optic System; GA.

Equipment calculations for flux budgets and gain margins.

Spare Parts; GA.

Data lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings not later than 1 month prior to the date of beneficial occupancy. The data shall include a list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 3 years of service.

#### Drawings

Fiber Optic System; GA.

Detail drawings including 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 contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function with its associated systems. 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 shall show final configuration, including location, type and termination of inside fiber optics and showing the location, duct and innerduct arrangement, or fiber assignment of outside plant. The ac power consumption and heat dissipation shall be shown under both normal and maximum operating conditions.

#### Instructions

Manufacturers' Recommendations; GA.

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 shall be submitted prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Operation and Maintenance Instructions; FIO.

Six copies of operating instructions outlining the step-by-step procedures required for system operation including description of each subsystem in its operating mode. Instructions shall include the manufacturer's name, service manual, parts list, and a brief description of equipment, components, and their basic operating features. Six copies of the maintenance instructions listing regular maintenance procedures, possible system failures, a troubleshooting guide for repairs, and simplified diagrams for the system as installed. A video describing operating and maintenance instructions may be included.

#### Statements

Test Plans; GA.

Test plans shall define 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.

#### Reports

Test Reports; FIO.

Test reports, in booklet form showing field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

#### Certificates

Manufacturer's certificate indicating compliance with transmission and reliability requirements. Where equipment or materials are specified to conform to the standards or publications and requirements of CFR, ANSI, NFPA, EIA, or UL, certificates attesting that the items furnished under this section of the specification conform to the specified requirements.

### PART 2 PRODUCTS

#### 2.1 GENERAL

The fiber optic telecommunications system shall consist of T1 channel banks, DS3 multiplexers, optical multiplexers, fiber optic cable, and physical mounting and terminating equipment. A switch specific interface may be provided at the DCO. Power supplies shall be provided as required to power individual components in accordance with the manufacturers requirements. Power supplies shall be provided in the chassis with the equipment they serve.

#### 2.2 T1 CHANNEL BANK

The channel bank shall combine 24 DS0 voice channels into a single T1 (DS3) signal. The channel bank shall include FXS, FXO, and 4-Wire E&M interfaces to allow direct connection to analog PBX. It shall support V.34 modems and direct inward dialing (DID). It shall be compatible for "Grade A" line interface. Channel banks shall include integrated diagnostic channel service units (CSU). Channel banks shall have Loop Start/Ground Start FXS capability.

#### 2.3 DS3 MULTIPLEXER

DS3 multiplexer shall combine up to 28 T1 (DS1) signals into a single T3 (DS3) signal. It shall have network interface functionality. It shall use bit error rate testing & simple network management protocol (SNMP), and support M23 or C-bit parity DS3 formats. It shall be compatible with B3ZS line code. It shall be capable of detecting and indicating alarm and loopback conditions. It shall provide 1:1 equipment protection switching.

#### 2.4 DS3 OPTICAL MULTIPLEXER

Optical multiplexer shall modulate 1 T3 (DS3) signal into FT3 (OC3) format for fiber optic transmission. It shall extend the range of T3 signals over fiber optic cable up to 70 km. The multiplexer shall be transparent to T3 signals. Optical multiplexer shall comply with ITU standards G.703 and G.921. The electrical interface shall include circuits for recovering data and clock according to ITU G.703. LED status indicators shall be included. A 1550 nm laser diode shall be used for transmitting on single mode fibers.

#### 2.5 SL1 INTERFACE

The existing switch is a Northern Telcom SL1.

## 2.6 RACK

## 2.7 CHASSIS

Chassis shall be provided to hold channel bank and multiplexer components and power supplies. Chassis shall be rack-mountable in a 482.6 mm (19 inch) rack.

## 2.8 FIBER OPTIC CONNECTOR PANEL

Fiber optic connector panel shall be rack-mountable in a 482.6 mm (19 inch) rack, 24 port, fiber optic patch panel with 24 ST connectors. The panel shall include strain relief and grounding provisions. The shelf shall cable management guides to organize excess slack and prevent damage to fibers. The front shall fold down for easy access to rear of connectors.

## 2.9 Y2K

## 2.10 SYSTEM REQUIREMENTS

### 2.10.2 Flux Budget/Gain Margin

FO links shall have a minimum gain margin of 6 dB. The flux budget is the difference between the transmitter output power and the receiver input power required for signal discrimination when both are expressed in dBm. The flux budget shall be equal to the sum of losses (such as insertion losses, connector and splice losses, and transmission losses) plus the gain margin. When a repeater or other signal regenerating device is inserted to extend the length of an FO circuit, both the circuit between the transmitter and the repeater-receiver, and the circuit between the repeater-transmitter and the receiver are considered independent FO links for gain margin calculations.

### 2.10.3 Receiver Dynamic Range

The dynamic range of receivers shall be large enough to accommodate both the worst-case, minimum receiver flux density and the maximum possible, receiver flux density. The receiver dynamic range shall be at least 15 dB. Where required, optical attenuators shall be used to force the FO link power to fall within the receiver dynamic range.

## 2.11 OPTICAL FIBERS

### 2.11.1 General

Optical fibers shall be coated with a suitable material to preserve the intrinsic strength of the glass. The outside diameter of the glass-clad fiber shall be nominally 125 microns, and shall be concentric with the fiber core. Optical fibers shall meet EIA 455-46A, EIA 455-65, and EIA 455-177A.

### 2.11.4 8.3 Micron Single Mode Fibers

Conductors shall be single-mode, graded index, solid glass waveguides with a nominal core diameter of 8.3 microns. The fiber shall have a transmission window centered at [1330] [1550] nanometer wavelength. The numerical aperture for each optical fiber shall be a minimum of 0.10. The

attenuation at 1330 nanometers shall be 0.5 dB/Km or less. The fibers shall be certified to meet EIA 455-170.

## 2.12 CABLE CONSTRUCTION

### 2.12.1 General

The cable shall contain a minimum of two fiber optic conductors for each full duplex circuit. The number of fibers in each cable shall be 12. Each fiber shall be protected by a protective tube. Cables shall have a jacketed strength member, and an exterior jacket. Cable and fiber protective covering shall be free from holes, splits, blisters, and other imperfections. The covering shall be flame retardant, moisture resistant, non-nutrient to fungus, ultraviolet light resistant as specified and nontoxic. Mechanical stress present in cable shall not be transmitted to the optical fibers. Strength members shall be non-metallic and shall be an integral part of the cable construction. The combined strength of all the strength members shall be sufficient to support the stress of installation and to protect the cable in service. The exterior cables shall have a minimum storage temperature range of minus 20 to plus 75 degrees C. (minus 40 to plus 167 degrees F.) Interior cables shall have a minimum storage temperature of minus 10 to plus 75 degrees C. (plus 14 to plus 167 degrees F.) All cables furnished shall meet the requirement of NFPA 70. Fire resistant characteristics of cables shall conform to Article 770, Sections 49, 50, and 51. A flooding compound shall be applied into the interior of the fiber tubes, into the interstitial spaces between the tubes, to the core covering, and between the core covering and jacket of all cable to be installed aerially, underground, and in locations susceptible to moisture. Flooded cables shall comply with EIA 455-81A and EIA 455-82B. Cables shall be from the same manufacturer, of the same cable type, and of the same size. Each fiber and protective coverings shall be continuous with no factory splices. Fiber optic cable assemblies, including jacketing and fibers, shall be certified by the manufacturer to have a minimum life of 30 years. Plenum cable shall meet UL 910, and riser cable shall meet UL 1666. FO cable shall be certified to meet the following: EIA 455-13, EIA 455-25A, EIA 455-41, EIA 455-47B, EIA 455-59, EIA 455-61, EIA 455-88, EIA 455-91, EIA 455-104A, and EIA 455-171.

### 2.12.2 Exterior Cable

#### 2.12.2.1 Aerial Cable

The optical fibers shall be surrounded by a loose tube buffer, shall be contained in a channel or otherwise loosely packaged to provide clearance between the fibers and inside of the container, and shall be extruded from a material having a coefficient of friction sufficiently low to allow the fiber free movement.

a. The cable outer jacket shall be medium density polyethylene material containing at least 2.6 percent carbon black with only black pigment added for additional coloring.

b. Tensile strength: Cables shall withstand an installation tensile load of not less than 2700 Newtons (608 pounds) and not less than 600 Newtons (135 pounds) continuous tensile load.

c. Impact and Crush resistance: The cables shall withstand an impact of 3 Newton-meters (1.7lbs/in) as a minimum, and shall have a crush resistance of 220 Newtons per square centimeter (317 pounds per square inch) as a minimum.

### 2.13 FO CONNECTORS (ST)

FO connectors shall be the straight tip, bayonet style, field installable, self-aligning and centering. FO connectors shall match the fiber core and cladding diameters. The connector coupler shall be stainless steel and the alignment ferrule shall be ceramic. FO equipment and cable shall use the same type connectors. Connector insertion loss shall be nominally 0.3 dB and less than 0.7 dB.

### 2.14 MECHANICAL SPLICES

Mechanical splices shall be suitable for installation in the field. External power sources shall not be required to complete a splice. Splices shall be self-aligning for optimum signal coupling. Mechanical splices shall not be used for exterior applications where they may be buried underground or laced to aerial messenger cables. Mechanical splices may be used for interior locations and within enclosures. Splice closures shall protect the spliced fibers from moisture and shall prevent physical damage. The splice closure shall provide strain relief for the cable and the fibers at the splice points.

### 2.15 CONDUIT, FITTINGS AND ENCLOSURES

Conduit shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR, and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, and as shown.

## PART 3 EXECUTION

### 3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. Interconnections, services, and adjustments required for a complete and operable data transmission system shall be provided.

#### 3.1.1 Interior Work

Conduits, tubing and cable trays for interior FO cable interior shall be installed as specified in Section 16415 ELECTRICAL WORK, INTERIOR and as shown. Cable installation and applications shall meet the requirements of NFPA 70, Article 770, Sections 52 and 53. Cables not installed in conduits or wireways shall be properly secured and neat in appearance, and if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

#### 3.1.2 Aerial Cable

Except as otherwise specified, poles and associated aerial hardware for an overhead FO cable system shall be installed as shown.

a. A messenger cable system to support aerial cables shall be furnished. The messenger system shall be capable of withstanding a minimum of 20,016 Newtons (4500 pounds) of tension, including appurtenances, guys, and hardware. Messenger cables shall be galvanized zinc coated steel or aluminum clad steel.

b. The messenger cables shall be grounded at dead ends, at the entrance to each facility, and at intervals not exceeding 305 meters.

(1000 feet.) [New grounding conductors and electrodes shall be provided at each ground connection.] [Where grounding connections are made in the vicinity of existing grounding conductors and electrodes, the grounding connection may be made by a bolted or welded connection to the existing grounding conductor.]

c. Aerial FO cables shall meet the horizontal, vertical and climbing space clearances prescribed in ANSI C2 and those of the installation.

d. Transitions from aerial cable to underground cable shall be as shown.

e. Splices in aerial cable shall be within 1 meter (3 feet) of a pole and placed inside a watertight enclosure. Drip loops shall be formed at the cable entrance to the enclosure. Lashing clamps shall be placed within 300 millimeters (12 inches) of the enclosure.

f. Loops shall be formed in the aerial cables at points of connection and at poles to prevent damage from thermal stress and wind loading. The communications cable shall be protected from chafing and physical damage with the use of spiral cut tubing and PVC tape, or plastic sleeves. The ground clearance of installed cabling shall be as shown.

g. Cable shall be run vertically and when possible shall use gravity to assist in cable pulling. Cable shall be pulled from top of run to bottom of run. Cable shall be hand pull if possible. If machine assistance is required, tension shall be monitored using dynamometers or load-cell instruments and shall not exceed specified cable tension limits. After installation, the vertical tension on the cable shall be relieved at maximum intervals of 30 meters (100 feet) using a split support grip.

h. Lashing wire shall be wound tightly around both the communication cable and the messenger cable by machine methods. The lashing wire shall have a minimum of 1 turn per 355 linear millimeters (1 turn per 14 linear inches) and not less than the number of turns per unit length that is recommended by the cable manufacturer for the distance between cable support points and the combined ice and wind loading and extreme wind loading shown or normally encountered loading for the installed location. Lashing clamps shall be placed at all poles and splices.

i. The ice and wind loading conditions to be encountered at this installation are as follows:

a. combined ice and wind loading:

- (1) radical thickness of ice 35mm
- (2) horizontal wind pressure - 80kmh
- (3) temperature - 0° C

b. extreme wind loading:

- (1) radical thickness of ice - 70mm
- (2) horizontal wind pressure - 160kmh
- (3) temperature -15° C

Except as otherwise specified, conduits, ducts, and manholes for underground FO cable systems shall be installed as shown.

a. Minimum burial depth for cable shall be 750 millimeters, (30 inches,) but not less than the depth of the frost line. Burial depth specified shall take precedence over any requirements specified elsewhere.

b. Where direct burial cable will pass under sidewalks, roads, or other paved areas and no existing conduits or duct banks are available, the cable shall be placed in a 25.4 millimeter (1 inch) rigid coated galvanized steel conduit or larger as required to limit conduit fill to 80 percent or less. Conduit may be installed by jacking or trenching, as approved.

c. Buried cables shall be placed below a plastic warning tape buried in the same trench or slot. The tape shall be 300 millimeters (12 inches) above the cable. The warning tape shall be continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 1300 millimeters (48 inch) intervals. The plastic tape shall be acid and alkali resistant polyethylene film, 76.2 millimeters (3 inches) wide with a minimum thickness of 0.1 millimeter. (0.004 inch.) Tape shall have a minimum strength of 12066 kilo Pascals (1750 pounds per square inch) lengthwise and 10342 kilo Pascals (1500 pounds per square inch) crosswise.

d. Transitions from underground cable to aerial cable shall be as shown.

e. For cables installed in ducts and conduit, a cable lubricant compatible with the cable sheathing material shall be used on all cables pulled. Pulling fixtures shall be attached to the cable strength members.

If indirect attachments are used, the grip diameter and length shall be matched to the cable diameter and characteristics. If an indirect attachment is used on cables having only central strength members, the pulling forces shall be reduced to ensure that the fibers are not damaged from forces being transmitted to the strength member. During pulling the cable pull line tension shall be continuously monitored using dynamometers or load-cell instruments, and shall not exceed the maximum tension specified by the cable manufacturer. The mechanical stress placed upon the cable during installation shall be such that the cable is not twisted or stretched. A cable feeder guide shall be used between the cable reel and the face of the duct or conduit to protect the cable and guide it into the duct or conduit as it is unspooled from the reel. As the cable is unspooled from the reel, it shall be inspected for jacket defects or damage. The cable shall be kinked or crushed and the minimum bend radius of the cable shall not be exceeded during installation. Cable shall be hand fed and guided through each manhole and additional lubricant shall be applied at all intermediate manholes. When practicable, the center pulling technique shall be used to lower pulling tension. That is, the cable shall be pulled from the center point of the cable run towards the end termination points.

The method may require the cable to be pulled in successive pulls. If the cable is pulled out of a junction box or manhole the cable shall be protected from dirt and moisture by laying the cable on a ground covering.

### 3.1.3 Service Loops

Each fiber optic cable shall have service loops of not less than 3 meters (9.8 feet) in length at each end. Loops in manholes shall be not less

than 90 meters (300 feet). The service loops shall be housed in a service loop enclosure.

#### 3.1.4 Splices

No splices will be permitted unless the length of cable being installed exceeds the maximum standard cable length available from a manufacturer or unless fiber optic pigtails are used to connect transmitters, receivers, or other system components for terminations to the fiber. Splices shall be made using the method recommended by the cable manufacturer. Splices shall be housed in a splice enclosure and shall be encapsulated with an epoxy, ultraviolet light cured splice encapsulant or otherwise protected against infiltration of moisture or contaminants. FO splices shall be field tested at the time of splicing. Fusion splices shall have less than 0.2 dB loss.

Mechanical splices shall have less than 0.5 dB loss. There shall be no more than 1 splice per kilometer (0.62 mile) in any of the FO cables excluding terminations. Field splices shall be located in cable boxes. Sufficient cable shall be provided in each splicing location to properly rack and splice the cables, and to provide extra cable for additional splices. Cable ends shall be protected with end caps except during actual splicing. During the splicing operations, means shall be provided to protect the unspliced portions of the cable and its fibers from the intrusion of moisture and other foreign matter.

#### 3.1.5 Connectors

Connectors shall be as specified in paragraph FO CONNECTORS. Fibers at each end of the cable shall have jumpers or pigtails installed of not less than 1 meter (3 feet) in length. Fibers at both ends of the cable shall have connectors installed on the jumpers. The mated pair loss, without rotational optimization, shall not exceed 1.5 dB. The pull strength between the connector and the attached fiber shall not be less than 22.7 kilograms. (50 pounds.)

#### 3.1.6 Identification and Labeling

Identification tags or labels shall be provided for each cable. Markers, tags and labels shall use indelible ink or etching which will not fade in sunlight, or in buried or underground applications. Markers, tags, and labels shall not become brittle or deteriorate for a period of 20 years. Label all termination blocks and panels with cable number or pair identifier for cables in accordance with EIA 606 and as specified. The labeling format shall be identified and a complete record shall be provided to the Government with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

### 3.2 TESTING

#### 3.2.1 General

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform testing.

#### 3.2.2 Contractor's Field Test

The Contractor shall verify the complete operation of the telecommunications system in conjunction with field testing associated with systems supported by the fiber optic system prior to formal acceptance testing. Field tests shall include a flux density test. These

tests shall be performed on each link and repeated from the opposite end of each link.

#### 3.2.2.1 Optical Time Domain Reflectometer Tests

Optical time domain reflectometer tests shall be performed using the FO test procedures of EIA 455-59. An optical time domain reflectometer test shall be performed on all fibers of the FO cable on the reel prior to installation. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. Photographs of the traces shall be furnished to the Government. An optical time domain reflectometer test shall be performed on all fibers of the FO cable after it is installed. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. If the optical time domain reflectometer test results show anomalies greater than 1 dB, the FO cable segment is unacceptable to the Government. The unsatisfactory segments of cable shall be replaced with a new segment of cable. The new segment of cable shall then be tested to demonstrate acceptability. Photographs of the traces shall be furnished to the Government for each link.

#### 3.2.2.2 Power Attenuation Test

Power attenuation test shall be performed at the light wavelength of the transmitter to be used on the circuit being tested. The flux shall be measured at the FO receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. If the circuit loss exceeds the calculated circuit loss by more than 2 dB, the circuit is unsatisfactory and shall be examined to determine the problem. The Government shall be notified of the problem and what procedures the Contractor proposes to eliminate the problem. The Contractor shall prepare and submit a report documenting the results of the test.

#### 3.2.2.3 Gain Margin Test

The Contractor shall test and verify that each circuit has a gain margin which exceeds the circuit loss by at least 6 dB.

#### 3.2.2.4 Performance Verification Test and Endurance Test

The FO system shall be tested as a part of the completed telecommunications system during the Performance Verification Test and Endurance Test.

### 3.3 TRAINING

#### 3.3.1 General

The Contractor shall conduct a training course for designated personnel in the maintenance of the FO system. The training shall be oriented to the specific system being installed under this specification. The Contractor shall furnish training materials and supplies.

#### 3.3.2 Maintenance Personnel Training

The system maintenance course shall be taught at the project site after completion of the endurance test for a period of 1 training day. A maximum of five personnel designated by the Government will attend the course. A training day shall be 8 hours of classroom or lab instruction,

including two 15 minute breaks and excluding lunchtime during the daytime shift in effect at the facility. Training shall include:

- a. Physical layout of the system and each piece of hardware.
- b. Troubleshooting and diagnostics procedures.
- c. Repair instructions.
- d. Preventative maintenance procedures and schedules.
- e. Calibration procedures. Upon completion of this course, the students shall be fully proficient in the maintenance of the system.

END OF SECTION

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## SECTION 16855

## ELECTRIC SPACE HEATING 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.

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210 (1985) Laboratory Methods of Testing Fans for Rating

AMCA 300 (1985; Rev 1987) Reverberant Room Method for Sound Testing of Fans

## AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-06 (1992) HVAC Systems and Equipment - I-P Edition

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419 (Rev A) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types Replaceable)

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1988; Rev 1) Enclosures for Industrial Control and Systems

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

UL 1025 (1980; Rev thru Feb 1990) Electric Air Heaters

UL 1042 (1987) Electric Baseboard Heating Equipment

## 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 SUBMITTALS:

## Drawings

Heating Equipment; FIO.

Detail drawings consisting of a complete list of equipment and material, manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall consist of a control schematic, complete power and control wiring diagrams, device ratings, part numbers and any other details required to demonstrate

that the system has been coordinated and will properly function as a unit. A nameplate drawing shall be included, with details of the type, size, and material of proposed nameplates, method recommended for fastening to the mounting surfaces, and raised or engraving details proposed. Nameplates shall be identified by number. Location of nameplates shall be shown on equipment arrangement drawings, with the nameplate number, and on wiring diagrams where devices or items of equipment appear.

### 1.3 STANDARD PRODUCTS

Material and equipment shall be a 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. The experience use shall include applications of equipment and materials under similar circumstances and of typical design and rating. Equipment items provided shall be capable of being serviced by an organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

### 1.4 NAMEPLATES

A nameplate, not smaller than 25 by 100 mm and raised or engraved with not less than .6 mm characters, shall be mounted on the front of the enclosure to adequately identify the space heater assembly. Fans and motors shall have the manufacturer's name, address, type or style, model or serial number and catalog number on a plate secured to the item of equipment.

### 1.5 CODES

Unless otherwise specified all work shall be in accordance with NFPA 70.

### 1.6 MANUFACTURER'S SERVICES

The Contractor shall obtain the services of the manufacturer's representative experienced in the installation, adjustment and operation of the equipment specified. The representative shall supervise the installation, adjustment and testing of the equipment.

### 1.7 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.

## 2.2 UNIT HEATERS (HORIZONTAL AND VERTICAL PROPELLER FAN TYPE)

### 2.2.1 Construction

Cabinet heaters shall have input wattage, (wattage,) voltage, phase, output wattage (Btu/hr output), cubic meter per second (cfm) air delivery, number of steps, and mounting height as shown or as specified. Unit heaters 5 kW and larger shall be three-phase. Complete unit heater assembly shall comply with the requirements of UL 1025 and the requirements specified. Each unit heater shall be provided with terminals for control circuits and a single source of power as necessary. Control transformers, where required, shall be factory installed and of adequate capacity. Electrical load for three-phase heaters shall be balanced between phases. Maximum discharge air temperature shall not exceed 60 degrees C when inlet air temperature is 16 degrees C.

### 2.2.2 Heating Elements

Heating elements shall consist of nickel-chromium heating wire embedded in magnesium-oxide insulating refractory and sealed in corrosion-resisting metallic sheath with fins. The ends of elements shall be sealed and enclosed in terminal box, and element sheath shall be mechanically pressed after filling to ensure maximum magnesium oxide compaction. Sheath and fins shall be cast aluminum or steel with fins brazed to sheath. Castings shall be free from defects of any nature. Steel sheath and fins shall be corrosion protected by high-temperature aluminized finish. Heat transfer between sheath and fins shall be uniform. Fins shall be spaced a maximum of twenty-four per 100 mm and fin surface temperature at any point shall not exceed 288 degrees C during normal operation. Elements shall be free from expansion noise and 60-cycle hum.

### 2.2.3 Enclosure

Heater fan, motor, and auxiliaries shall be contained in a housing. All metal surfaces of housing shall be not less than 18 US gauge. Housings shall have the manufacturer's standard factory baked enamel finish. All parts shall be rigidly braced with heavy steel plates or structural steel shapes to prevent vibration and maintain alignment. Housing design shall provide ready access to interior parts without unfastening housing from mounting bracket. Swivel mounting brackets shall be furnished with each heater for wall or ceiling mounting as indicated. Each unit heater shall develop the floor area coverage and air throw required by the heater layout shown. The floor area coverage and air throw data shall be included on the detail drawing submittal.

### 2.2.4 Louvers

Horizontal air discharge units shall have individually adjustable horizontal louvers to direct discharge air horizontally as desired. A louvered back, heavy grille, or wire guard shall be provided for inlet air. Vertical air discharge units shall be provided with individually adjustable louvers so that air-flow pattern can be adjusted in all directions. Discharge cones or diffusers shall be substituted where required.

### 2.2.5 Fans and Motors

Fans shall be the propeller type direct connected to fan motor, dynamically balanced, and designed specifically for unit heater application and low noise level. Sleeve type bearings shall have ample provisions for lubrication and oil reservoir, and shall be effectively sealed against loss of lubrication and entrance of dirt. Ball and roller type bearings shall be sealed, self-aligning and permanently lubricated. Fan motor shall be totally enclosed, continuous duty with built-in manually reset thermal overload protection. Motors 1/2 horsepower and larger shall be three-phase unless otherwise shown. Single-phase motors shall be permanent split capacitor, capacitor-start, or shaded pole type. Motor shall operate from the same power supply as the heater, and at the same voltage unless a factory-furnished step-down transformer is provided. Motor speed shall not exceed 1,800 rpm.

### 2.2.6 Limit Controls

Manual reset thermal overheat protection of unit shall be provided to protect against overheating of the unit and mounted in a convenient location.

### 2.2.7 Contactor

Unit shall have factory-installed magnetic contactor, for remote thermostatic operation, which shall disconnect all ungrounded conductors to the heater.

Contactors shall be rated for 100,000-cycle duty. A control transformer shall be provided when necessary to supply 120 volt thermostat control circuit for each heater.

#### 2.2.8 Remote Controls

Room thermostat for pilot duty shall be provided where shown. Thermostat shall have an approximate range of from 12 to 21 degrees C and an operating differential of 1.8 degrees C or less. A fused safety disconnect switch or circuit breaker, and a low-voltage-release stop-start push button station shall be provided in NEMA ICS 6, Type 1 enclosures and wall mounted 1372 mm above floor near the heater or as shown. Control devices shall be connected to the unit heater with wire in conduit.

#### 2.2.9 Wiring

Heaters shall be furnished complete, factory prewired to terminal strips, ready to receive branch circuit and control connections.

### PART 3 EXECUTION

#### 3.1 HEATERS

Heaters shall be installed at the locations shown and in accordance with the recommendations of the manufacturer.

END OF SECTION