

2. AMENDMENT/MODIFICATION NO. 0008	3. EFFECTIVE DATE 5 February 2003	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. <i>(If applicable)</i>
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6. ISSUED BY  LOS ANGELES DISTRICT, COE CESPL-CT-WEST REGION BRANCH P.O. BOX 532711 LOS ANGELES, CA 90053-2325	7. ADMINISTERED BY <i>(If other than Item 6)</i>
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8. NAME AND ADDRESS OF CONTRACTOR <i>(No., street, county, State and ZIP Code)</i>	(✓)	9A. AMENDMENT OF SOLICITATION NO. DACW09-02-B-0004
	X	9B. DATED <i>(SEE ITEM 11)</i> 17 OCTOBER 2002
		10A. MODIFICATION OF CONTRACTS/ORDER NO.
		10B. DATED <i>(SEE ITEM 13)</i>

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.

(✓)	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: <i>(Specify authority)</i> 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 <i>(such as changes in paying office, appropriation date, etc.)</i> SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 101.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF FAR 101.103(b).
	D. OTHER <i>(Specify type of modification and authority)</i>

**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.)*  
**PRADO DAM EMBANKMENT AND OUTLET WORKS,  
 RIVERSIDE COUNTY, CA**

This amendment is issued to:

a. REPLACE project\_7.pdf with project\_8.pdf; PROJECT TABLE OF CONTENTS  
 b. CORRECTIONS are made to the following specifications:

(CONTINUED ON NEXT SHEET)

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

Amendment 0008

February 5, 2003

DACW09-02-B-0004

PRADO DAM EMBANKMENT AND OUTLET WORKS, RIVERSIDE COUNTY, CA

**BLOCK 14 – Continued****b. CORRECTIONS** are made to the following Specification Sections in the Solicitation:

00010\_8.pdf; SECTION 00010 Bid Schedule

Changes consist of:

- Revise quantity of bid item #35 from "15,260 C.Y." to "**15,502 C.Y.**"
- Revise title of bid item 92a from "Cement, low heat" to "**Cement**"

01200\_8.pdf; SECTION 01200 General Requirements

Changes consist of:

- Insert paragraph **1.23, Visitor Center Trailer**

01500\_8.pdf; SECTION 01500 Quality Assurance

Changes consist of:

- Insert after paragraph 1.6: paragraph **1.7, Survey Equipment**

02510\_8.pdf; SECTION 02510 Water Distribution System

Changes consist of:

- Revise paragraph 2.4.3, 3<sup>rd</sup> sentence: revise to read "**The Contractor shall include with his submittal, written certification ...**".

03305\_8.pdf; SECTION 03305 Cast-In-Place Structural Concrete

Changes consist of:

- Revise paragraph 2.1.1.3, revise to "**...Grade 100 or 120**".
- Revise paragraph 2.1.5.3, revise Coarse Aggregate gradations as shown.
- Revise paragraph 2.2.2, first sentence: change "...below elevation 500..." to "**...below elevation 545...**".

11290\_8.pdf; SECTION 11290 Emergency Closure Gates for Regulating Outlets

Changes consist of:

- Revise paragraph 2.1.3.10, 2<sup>nd</sup> sentence: replace as shown.
- Revise paragraph 2.4, 2<sup>nd</sup> sentence: revise to read "**...included in the shop drawing submittal.**"
- Revise paragraph 2.5, last sentence: revise to read "**...submitted with the shop drawing submittal.**"

14320\_8.pdf; SECTION 14320 Gate Room Underhung Crane

Changes consist of:

- Revise paragraph 3.4.1, 2<sup>nd</sup> sentence: revise to read "**...submitted with the shop drawing submittal.**"
- Revise paragraph 3.4.2, last sentence: revise to read "**...submitted with the shop drawing submittal.**"

15095\_8.pdf; SECTION 15095 Emergency Closure Gates for Regulating Outlets

Changes consist of:

- Revise paragraph 1.6.4, 2<sup>nd</sup> sentence: revise to read "**...state so in the shop drawing submittal...**"
- Revise paragraph 1.6.4, Item 13: Revise as shown
- Insert paragraph **1.11.1, Field Wet Test**
- Revise paragraph 2.2, last sentence: revise sentence to "**A complete list of special tools shall be furnished by Contractor.**"

Amendment 0008

February 5, 2003

DACW09-02-B-0004

## PRADO DAM EMBANKMENT AND OUTLET WORKS, RIVERSIDE COUNTY, CA

15096\_8.pdf; SECTION 15096 Maintenance Bulkhead for Low Flow Outlets

Changes consist of:

- Revise paragraph 1.5.5, 2<sup>nd</sup> sentence: revise to read **"...state so in the shop drawing submittal..."**
- Revise paragraph 1.5.5, Item 12: Revise as shown.
- Insert paragraph **1.10.1.1, Field Wet Test**

15097\_8.pdf; SECTION 15097 Regulating Outlet Slide Gates

Changes consist of:

- Revise paragraph 1.6.5, 2<sup>nd</sup> sentence: revise to read **"...state so in the shop drawing submittal..."**
- Revise paragraph 1.6.5: Revise Item 17 to **"Bearing material shall be bronze as stated in paragraph 2.1.2"**
- Insert paragraph **1.10.1, Field Wet Test**
- Revise paragraph 2.1.3, 2<sup>nd</sup> sentence: change "316 stainless" to **"316L stainless"**.
- Revise paragraph 2.1.3: add after last sentence **"The skinplate contact surfaces as well as the seal seats shall be machined to 63 microns."**
- Revise paragraph 2.1.6: add after last sentence **"All seat surfaces shall be machined to achieve 63 microns."**
- Revise paragraph 2.2, last sentence: delete the words "with his Bid"
- Revise paragraph 3.2.1.3, 4<sup>th</sup> sentence: replace as shown.
- Revise paragraph 3.2.1.5: revise as shown.

15099\_8.pdf; SECTION 15099 Low Flow Outlet Knife Gate Throttling Valves and Operators

Changes consist of:

- Revise paragraph 3.5, 2<sup>nd</sup> sentence: revise to read **"...along with the shop drawing submittal..."**

15300\_8.pdf; SECTION 15300 Piping Systems - General

Changes consist of:

- Revise paragraph 2.1.6.1, last sentence: delete coal-tar enamel paint and insert painting requirements as shown.

c. **REPLACE** the following Plans/Drawings in the Solicitation with the enclosed Plans/Drawings:

<u>File No.</u>	<u>Sheet No.</u>	<u>Drawing Title</u>
121/116 Rev. D	C-2	INDEX TO CONTRACT DRAWINGS, GENERAL LEGEND AND ABBREVIATIONS
121/242 Rev. B	S40	REGULATING TRANSITION STRUCTURE - SECTIONS

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16475 COORDINATED POWER SYSTEM PROTECTION

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SECTION 00010 - BID SCHEDULE

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
1	Mobilization and Preparatory Work	1	L.S.	_____	_____
2	Diversion and Control of Water	1	L.S.	_____	_____
3	Clear Site and Remove Obstructions - Outlet Works, Approach Channel, & Abutments	1	L.S.	_____	_____
4	Clear Site and Remove Obstructions - Borrow Areas	1	L.S.	_____	_____
5	Demolition of Existing Intake Structure and Access Bridge	1	L.S.	_____	_____
6	Abandon Existing Outlet Conduit	1	L.S.	_____	_____
7	Excavation, Outlet Works - Sta. 0+00 to Sta. 10+00	692,100	C.Y.	_____	_____
8	Excavation, Outlet Works - Sta. 10+00 to Sta. 18+13.5	470,700	C.Y.	_____	_____
9	Excavation, Outlet Works - Sta. 18+13.5 to Sta. 49+93	317,000	C.Y.	_____	_____
10	Excavation, Outlet Works - Sta. 49+93 to Sta. 54+00	48,000	C.Y.	_____	_____
11	Derrick Stone	9,700	Tons	_____	_____
12	Excavation, Removal of Gravel Blanket	80,200	Tons	_____	_____
13	Excavation, Removal of Stone Protection	6,300	Tons	_____	_____
14	Excavation, Stripping	3,000	C.Y.	_____	_____
15	Excavation, Toe	8,100	C.Y.	_____	_____
16	Excavation, Existing Embankment Crest	51,500	C.Y.	_____	_____
17	Foundation Preparation, Zone II Contact Area	1,200	S.Y.	_____	_____
18	Embankment, Zone I Material	1,132,400	C.Y.	_____	_____
19	Embankment, Zone II Material	233,600	C.Y.	_____	_____
20	Embankment, Transition Zone Material	257,700	C.Y.	_____	_____
21	Additional Rolling	60	Hours	_____	_____
22	Compacted Fill, Levee	82,000	C.Y.	_____	_____
23	Structural Backfill	23,500	C.Y.	_____	_____
24	Miscellaneous Fill	208,500	C.Y.	_____	_____
25	Mitigation Fill	4,900	C.Y.	_____	_____
26	Subdrainage System, Outlet Works	1	L.S.	_____	_____
27	Aggregate Base Course	6,000	Tons	_____	_____
28	Asphalt Concrete Pavement	3,300	Tons	_____	_____
29	Stone Protection	108,800	Tons	_____	_____
30	Gravel Blanket Protection	37,500	Tons	_____	_____
31	Bedding Material for Stone Protection	54,400	Tons	_____	_____

32 Stone for Grouted Stone Protection	8,000	Tons	_____	_____
33 Grouting Stone Protection	2,000	C.Y.	_____	_____
34 Concrete, Intake Tower Structure				
a. Concrete, Intake Tower Structure - Elev. 545' and Below	22,300	C.Y.	_____	_____
b. Concrete, Intake Tower Structure - Above Elev. 545'	970	C.Y.	_____	_____
c. Concrete, Float Well Intake	230	C.Y.	_____	_____
35 Concrete, Transition Structure	<b>15,502</b>	<b>C.Y.</b>	_____	_____
36 Concrete, Outlet Conduit	17,855	C.Y.	_____	_____
37 Concrete, Stilling Basin				
a. Concrete, Stilling Basin Invert - Sta.18+13.50 to Sta.21+02.50	8,400	C.Y.	_____	_____
b. Concrete, Stilling Basin	6,600	C.Y.	_____	_____
38 Concrete, Drop Structure Retaining Wall	467	C.Y.	_____	_____
39 Concrete, Outlet Works Sta. 21+02 to Sta. 49+93	24,500	C.Y.	_____	_____
40 Concrete, Access Road	230	C.Y.	_____	_____
41 Concrete, Stop Log Pads	35	C.Y.	_____	_____
42 Concrete, Lean Mix Concrete Backfill	7,200	C.Y.	_____	_____
43 Concrete Reinforcement	6,418	Tons	_____	_____
44 Structural Steel	34	Tons	_____	_____
45 Miscellaneous Steel and Metal Work	1	L.S.	_____	_____
46 Interceptor Drain	288	L.F.	_____	_____
47 V-Ditch	445	L.F.	_____	_____
48 Control House Access Bridge	1	L.S.	_____	_____
49 Stilling Basin Access Road Bridge	1	L.S.	_____	_____
50 Mechanically Stabilized Earth Walls	18,535	S.F.	_____	_____
51 MSE Instrumentation	1	L.S.	_____	_____
52 42" Culvert Extension	1	L.S.	_____	_____
53 Outlet Works Side Drain, Sta. 33+68	1	L.S.	_____	_____
54 Outlet Works Side Drain, Sta. 35+38	1	L.S.	_____	_____
55 Outlet Works Side Drain, Sta. 41+60	1	L.S.	_____	_____
56 Accusonic Flow Meters	1	L.S.	_____	_____
57 SAWPA Relocation/Protection				
a. 60-inch Sewer Pipe Encasement	299	L.F.	_____	_____
b. Raise Exist. 48-inch Dia. Precast Concrete Manhole	1	L.S.	_____	_____
c. SARI Pipeline Reaches IV-A and IV-B Relocation	1	L.S.	_____	_____
d. Abandonment of Existing 60-inch SARI Pipeline	1	L.S.	_____	_____

e.	Dual 48-inch HDPE Pipeline in Existing Outlet Structure	1	L.S.	_____	_____
f.	48-inch PVC Lined RCP, Fittings and Valves	1	L.S.	_____	_____
58 Water Distribution System					
a.	Chlorination Equipment	1	L.S.	_____	_____
b.	Pressurized Water Storage Tank	1	L.S.	_____	_____
c.	Water System Piping, Valves, and Appurtenances	1	L.S.	_____	_____
d.	Concrete Well Slab Foundation	1	L.S.	_____	_____
e.	3" Dia. PVC Well Discharge Pipe	1,746	L.F.	_____	_____
59 Water Well System					
a.	Bore Hole and Well Development	1	L.S.	_____	_____
b.	Well System Electrical Distribution	1	L.S.	_____	_____
60	Observation Well	8	EA.	_____	_____
61	Double Cable Trash Boom	1	L.S.	_____	_____
62	Metal Beam Guard Rail	3,063	L.F.	_____	_____
63 Chain Link Fence and Gates					
a.	5' Chain Link Fence	1,780	L.F.	_____	_____
b.	6' Chain Link Fence	2,820	L.F.	_____	_____
c.	6' Chain Link Fence w/ Slats	66	L.F.	_____	_____
d.	Barbed Wire Fence	654	L.F.	_____	_____
e.	6' Chain Link Gate (W=10')	1	EA.	_____	_____
f.	6' Chain Link Gate (W=20')	1	EA.	_____	_____
64	Pipe Gate	1	EA.	_____	_____
65	Settlement Plates	25	EA.	_____	_____
66	Survey Monuments	3	EA.	_____	_____
67	Staff Gages	26	EA.	_____	_____
68 Hydroseeding					
a.	First 62 Acres	62	Acre	_____	_____
b.	Over 62 Acres	85	Acre	_____	_____
69 Hydroseeding Maintenance					
a.	First 62 Acres	62	Acre	_____	_____
b.	Over 62 Acres	85	Acre	_____	_____
70	Generator and Storage Building	1	L.S.	_____	_____
71	Gaging Station	1	L.S.	_____	_____
72	Gage Station Electrical Distribution	1	L.S.	_____	_____
73	Seismic Instrumentation	1	L.S.	_____	_____

74 Stop Logs	16	EA.	_____	_____
75 Regulating Outlet Slide Gates	6	EA.	_____	_____
76 Emergency Closure Gates	2	EA.	_____	_____
77 Low-Flow Outlet Control Valves	2	EA.	_____	_____
78 Low-Flow Outlet Shut-Off Valves	2	EA.	_____	_____
79 Low-Flow Bulkhead	1	L.S.	_____	_____
80 Underhung Crane	1	L.S.	_____	_____
81 Piping Systems	1	L.S.	_____	_____
82 Plumbing	1	L.S.	_____	_____
83 Washroom Accessories	1	L.S.	_____	_____
84 Septic System	1	L.S.	_____	_____
85 HVAC System	1	L.S.	_____	_____
86 Power Distribution System	1	L.S.	_____	_____
87 Generator Set	1	L.S.	_____	_____
88 Fire Protection System	1	L.S.	_____	_____
89 Passenger Elevator	1	L.S.	_____	_____
90 Quality Assurance Support	1	L.S.	_____	_____
91 As-built Drawings	1	L.S.	_____	_____

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SUB TOTAL ESTIMATED AMOUNT OF BASE BID (LINE ITEMS 0001-0091):      \$      -

Bid Item 92 - ALTERNATIVE 1

a. <b>Cement</b>	130,475	Cwt	_____	_____
b. Fly Ash	3,300	Tons	_____	_____
c. Water Reducing Admixture	959	Gal	_____	_____

SUBTOTAL ESTIMATED AMOUNT OF ALTERNATIVE 1 (LINE ITEMS 0092A-0092C):      \$      -

Bid Item 93 - ALTERNATIVE 2

a. Cement, regular heat	49,120	Cwt	_____	_____
b. Ground Granulated Blast Furnace Slag	5,526	Tons	_____	_____
c. Water Reducing Admixture	1,139	Gal	_____	_____

SUBTOTAL ESTIMATED AMOUNT OF ALTERNATIVE 2 (LINE ITEMS 0093A-0093C):      \$      -

**BIDDERS ARE TO SUBMIT PRICES ON ALL LINE ITEMS IN THE BASE BID (0001-0091). IN ADDITION, BIDDERS MUST SUBMIT PRICES ON ALTERNATIVE 1 (0092A-0092C) OR ALTERNATIVE 2 (0093A-0093C) NOT BOTH. THE GOVERNMENT CONTEMPLATES AWARD OF ONE CONTRACT TO THE RESPONSIVE, RESPONSIBLE BIDDER WHO SUBMIT THE LOWEST BID FOR THE BASE BID AND ALTERNATIVE 1; OR THE LOWEST BID FOR THE BASE BID AND ALTERNATIVE 2. ANY BIDDER WHO SUBMITS A BID FOR BOTH ALTERNATIVE 1 AND ALTERNATIVE 2 WILL BE DEEMED NON-RESPONSIVE AND THEIR BID WILL BE REJECTED.**

**SECTION 00010 Bidders Notes/Bid Schedule**

1. All extensions of the unit prices shown will be subject to verification by the Government. In case of variation between the unit price and the extension, the unit price will be considered to be the bid.
2. If a modification to a bid based on unit prices is submitted which provides for a lump sum adjustment to the total estimated amount, the application of the lump sum adjustment to each unit price in the Price Schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the Price Schedule.
3. Prices must be submitted on all individual items of the Price Schedule, otherwise the bid will be considered non-responsive and will be rejected.
4. For the purpose of initial evaluation of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the Price Schedule as submitted by the bidder:
  - a. Obviously misplaced decimal points will be corrected;
  - b. In case of discrepancy between the unit price and the extended price, the unit price will govern;
  - c. Apparent errors in extensions of unit prices will be corrected;
  - d. Apparent errors in addition of lump sum and extended prices will be corrected.
5. For the purpose of bid evaluation, the Government will proceed on the assumption that the bidder intends the bid to be evaluated on the basis of unit prices the totals arrived at by the resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.
6. The lump sum "LS" line items in the Price Schedule are not "Estimated Quantity" line items and are not subject to the "Variation in Estimated Quantity" contract clause.
7. The Contract Clause 52.232-27, "Prompt Payment for Construction Contracts" requires that the name and address of the contractor official, to whom payment is to be sent, be the same as that in the contract or in a proper Notice of Assignment.
8. Principal Contracting Officer. The Contracting Officer who signs this contract will be the Principal Contracting Officer for this contract. However, any Contracting Officer assigned to the Los Angeles District, contracting within his authority, may take formal action on this contract when the Principal Contracting Officer is unavailable and the action needs to be taken.
9. Amounts and prices shall be indicated in either words or figures, NOT BOTH.
10. Payment of Electronic Funds Transfer (EFT) is the mandatory method of payment. The Contractors attention is directed to Contract Clause NO. 52.232-33 "Mandatory Information for Electronic Funds Transfer" located in Section 00700.
11. The bidder shall distribute his indirect costs (overhead, profit, bond, etc.,) over all items in the Price Schedule. The Government will review all submitted Price Schedules for any unbalancing of the items. Any submitted Price Schedule determined to be unbalanced may be considered non-responsive and cause the bidder to be ineligible for contract award.
12. The bidder shall furnish all plant, labor, material, equipment, etc., necessary to perform all work in strict accordance with the terms and conditions set forth in the contract in include all attachments thereto.
13. Some quantities are ESTIMATED, the bidders prices MUST BE FIRM.
14. Bidder is cautioned to check his Price Schedule carefully prior to submission. If the Price Schedule contains unit prices, they should be round off to the second decimal point only NOT EXTENDED FUTHER.

15. Bidders attention is directed to Section 00100 "Instructions to Bidders" Clause No. 52.0214-4001, entitled "Directions for Submitting Bids". Please note that there are Special Instructions Pertaining to Hand-Carried Bids.

16. Contractor is required to fill in Cage code (Reference Section 00600, entitled "Required Central Contractor Registration" Mar 1998) and DUNS Number (Reference Section 00600, entitled, "Data Universal Numbering System (DUNS) Number" Jun1999) in Block No. 15 on Standard Form 1442, Name and Address Block (Cage Code under Code and DUNS No. under Facility Code respectively).

17. Bidders are to submit prices on all line items in the Base Bid (0001-0091). In addition, bidders must submit prices on Alternative 1 (0092A-0092C) or Alternative 2 (0093A-0093C) NOT BOTH. The Government contemplates award of one contract to the responsive, responsible bidder who submit the lowest bid for the Base Bid and Alternative 1; or the lowest bid for the Base Bid and Alternative 2. Any bidder who submits a bid for BOTH Alternative 1 and Alternative 2 will be deemed non-responsive and their bid will be rejected.

CERTIFICATE OF CORPORATE PRINCIPAL

1) IF THE OFFEROR IS A JOINT VENTURE, COMPLETE THE FOLLOWING:

\_\_\_\_\_  
(Company Name) (Signature) (Title)

\_\_\_\_\_  
(Company Name) (Signature) (Title)

\_\_\_\_\_  
(Company Name) (Signature) (Title)

2) IF THE OFFEROR IS PARTNERSHIP, LIST FULL NAME OF ALL PARTNERS:

\_\_\_\_\_  
(Company Name) (Signature) (Title)

\_\_\_\_\_  
(Company Name) (Signature) (Title)

\_\_\_\_\_  
(Company Name) (Signature) (Title)

3) IF THE OFFEROR IS A CORPORATION, THE FOLLOWING CERTIFICATION SHOULD BE COMPLETED:

CERTIFICATION AS TO CORPORATE PRINCIPAL

I, \_\_\_\_\_, certify that I am the Secretary of the corporation named as principal in the

within contract; that \_\_\_\_\_, who signed the said contract on behalf of the principal, was the

\_\_\_\_\_ of the corporation; that I know his signature and that his signature is genuine; and that said contract was duly signed, sealed and attested for in behalf of said corporation by authority of its governing body.

\_\_\_\_\_  
CORPORATE PRINCIPAL

CORPORATE SEAL

SECRETARY \_\_\_\_\_

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## SECTION 01200

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## SECTION 01200

## GENERAL REQUIREMENTS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ENGINEERING MANUALS (EM)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

## FEDERAL SPECIFICATIONS (FS)

FS FF-B-575 (Rev C) Bolts, Hexagon and Square  
FS FF-N-105 (Rev B; Am 3 Int Am 4) Nails, Brads, Staples and Spikes: Wire, Cut and Wrought  
FS FF-N-836 (Rev B; Am 2) Nut: Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat  
FS MM-L-751 (Rev H) Lumber; Softwood  
FS TT-E-529 (Rev D) Enamel, Alkyd, Semi-Gloss  
FS TT-P-25 (Rev E; Am 2) Primer Coating, Exterior (Undercoat for Wood, Ready-Mixed, White and Tints)

## NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1 (1983) Construction and Industrial Plywood

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Location of Contractor's Office

SD-02 Shop Drawings

Temporary Access and Haul Roads; G.

### 1.3 CONSTRUCTION SIGNS

The Contractor shall construct and/or erect the following signs. The signs shall be erected as soon as possible and within 15 days after commencement of work under this contract.

#### 1.3.1 Construction Signs Shall Meet The Following Material Requirements

- a. Lumber shall conform to FS MM-L-751, and shall be seasoned Douglas Fir, S4S, Grade D or better except that posts, braces and spacers shall be construction Grade (WCLB).
- b. Plywood shall conform to NIST PS 1, grade A-C, Group 1, exterior type.
- c. Bolts, Nuts and Nails. Bolts shall conform to FS FF-B-575, nuts shall conform to FS FF-N-836, and nails shall conform to FS FF-N-105.
- d. Paints and Oils. Paints shall conform to FS TT-P-25 for primer and FS TT-E-529 for finish paint and lettering.

#### 1.3.2 The Following Construction Signs Shall Be Constructed

- a. One project sign at location designated by the Contracting Officer. The project sign shall be constructed as detailed in Figure 1 and Figure 2.
- b. Eight hard hat signs at locations directed. Hard hat signs shall be constructed as detailed in Figure 3. Decals and safety signs will be furnished by the Contracting Officer.
- c. Warning Signs facing approaching traffic on all haul roads crossing under overhead power transmission lines.
- d. Warning Signs shall be constructed of plywood not less than ½ inch thick and shall be securely bolted to the supports with the bottom of the sign face 3 feet above the ground. The sign face shall be 2 x 4 feet and all letters shall be 4 inches in height. The text of the "Powerline" warning signs shall be "WARNING: OVERHEAD TRANSMISSION LINES".
- e. Warning signs shall be placed indicating that explosives are being used in the area at locations designated by the Contracting Officer. The text of the "Explosives" warning signs shall be "WARNING: EXPLOSIVES BEING USED IN AREA".

#### 1.3.3 Painting

All exposed surfaces and edges of plywood shall be given one coat of linseed oil and be wiped prior to applying primer. All exposed surfaces of signs and supports shall be given one coat of primer and 2 finish coats of white paint. Except as otherwise indicated, lettering on all signs shall be black and sized as indicated.

#### 1.3.4 Bulletin Board at the Contractor's Office

A weatherproof bulletin board, approximately 36 inches wide and 30 inches high, with hinged glass door shall be provided adjacent to or mounted on the Contractor's project office. If adjacent to the office, the bulletin board shall be securely mounted on no less than 2 posts. Bulletin board and posts shall be painted or have other approved factory finish. The bulletin board shall be easily accessible at all times and shall contain wage rates, equal opportunity notice, and such other items required to be posted

#### 1.4 LOCATION OF CONTRACTOR'S OFFICE

Location of the Contractor's Office shall be approved by the Contracting Officer. The Contractor's job site office shall be located so that people visiting, such as salespersons or personnel seeking employment, will not have to enter the work area to get to the office. No parking of private vehicles shall be permitted in the working areas except as otherwise approved. At approved locations, adequate parking areas shall be constructed for the Contractor's and subcontractor's employees. The office site and parking areas shall be adequately drained and have suitable access.

#### 1.5 MAINTENANCE OF PROJECT FACILITIES

The Contractor shall maintain project facilities in good condition throughout the life of the project. Upon completion of work under this contract, facilities covered under this section will remain the property of the Government.

##### 1.5.1 General

The Contractor shall be responsible for maintaining all project facilities, including the existing Prado Dam Resident Office and the laboratory buildings.

##### 1.5.2 Maintenance Requirements

Maintenance of the project facilities shall include daily janitorial service, including cleaning of tile floors and washing of windows twice a month. Toilet facilities shall be kept clean and sanitary and fully supplied at all times. All janitorial services shall be performed at such a time and in such manner to least interfere with the use of the Government facilities, but only during periods when the building and trailers are occupied. Maintenance includes providing potable bottled water service, trash removal, servicing of sewage tank, monthly air conditioning service, and the payment of monthly billings associated with these utilities and services with the exception of the telephone and power billings. The project facilities shall be kept clear of debris. Trash service shall also be provided (3 cy trash dumpster with weekly pickups). The Contractor shall remove and dispose of all broken test cylinders from the testing laboratory bi-weekly. Any required replacement and/or repairs for the project facilities or grounds shall be performed by the Contractor at no additional cost to the Government. Maintenance shall also include bi-annual pest control service for all buildings and trailers.

#### 1.6 SECURITY GUARD SERVICE

The Contractor shall provide 24 hour a day, seven day a week security guard service for the Prado Dam construction site. The security guard service shall perform hourly checks of various locations throughout the project

site, as directed by the Contracting Officer, to assure overall security and prevent vandalism and theft during non duty hours. A security guard shall be assigned to control the entrance gate to Prado Dam.

#### 1.7 PROTECTION OF EXISTING WORK

Before beginning any cutting or removal work, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of the work. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Government, and any damage to such work shall be repaired or replaced as approved by the Contracting Officer at no additional cost to the Government. The Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required. The Contractor shall insure that structural elements are not overloaded and be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract.

#### 1.8 PUBLIC UTILITIES, NOTICES, AND RESTRICTIONS

##### 1.8.1 General

The approximate location of all pipe lines, power and communication lines, and other utilities known to exist within the limits of the work are indicated on the drawings. The sizes, locations, and names of owners of such utilities are given from available information, but their accuracy is not guaranteed. Except as otherwise indicated on the drawings, all existing utilities will be left in place and the Contractor shall conduct his operations in such a manner that the utilities will be protected from damage at all times, or arrangements shall be made by the Contractor for their relocation at the Contractor's own expense. The Contractor shall be responsible for any damage to utilities known to exist and shall reimburse the owners for such damage caused by his operations.

##### 1.8.2 Relocation or Removal

Utilities to be relocated or removed not as part of this contract are designated "To be Relocated by Others" or "To be Removed by Others", respectively. Utilities shown on the plans and not so designated will be left in place and be subject to the provisions of the CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS. The Contractor may make arrangements with the owner for the temporary relocation and restoration of utilities not designated to be relocated, or for additional work in excess of the work needed to relocate utilities designated for relocation at no additional cost to the Government.

##### 1.8.3 Utilities Not Shown

If the Contractor encounters, within the construction limits of the entire project, utilities not shown on the plans and not visible as of the date of this contract and if such utilities will interfere with construction operations, he shall immediately notify the Contracting Officer in writing to enable a determination by the Contracting Officer as to the necessity for removal or relocation. If such utilities are left in place, removed or relocated, as directed by the Contracting Officer, the Contractor shall be entitled to an equitable adjustment for any additional work or delay.

#### 1.8.4 Coordination

The Contractor shall consult and cooperate with the owner of utilities that are to be relocated or removed by others to establish a mutual performance schedule and to enable coordination of such work with the construction work. These consultations shall be held as soon as possible after award of the contract or sufficiently in advance of anticipated interference with construction operations to provide required time for the removal or relocation of affected utilities.

The Contractor shall be responsible for coordinating their activities with other contractors performing work in the area. This shall include, but is not limited to, coordination with Caltrans and their Contractor for work on the Highway 71 bridge crossing the Santa Ana River and the future expansion of the 71/91 interchange.

The Contractor shall be responsible to coordinate with the United States Geological Survey (USGS) for the removal of instruments within the seismic sheds. The USGS contact for removal of the instruments at Prado Dam is:

Mr. Arnie Acosta  
Telephone: (626) 583-7234  
Pager: (818) 542-4638

or

Edna Anjal  
Telephone: (626) 583-7235

USGS shall be notified a minimum of 30 days prior to the removal of the seismic sheds. The Contractor shall not attempt to remove any of the instruments and associated hardware, however, what remains shall become the property of the contractor for removal and disposal.

#### 1.8.5 Notices

##### 1.8.5.1 Utilities to be Relocated or Protected

The Contractor shall notify the Contracting Officer, in writing, 14 calendar days prior to starting work on any utility to be relocated or protected. On each relocation, notification shall include dates on which the Contractor plans excavation, by-pass work, removal work and/or installation work, as applicable. The Contractor shall also notify the following representatives of utility owners not less than 30 days, unless otherwise specified, prior to start of work in the vicinity of their respective utilities:

Southern California Gas Company  
Mr. Tim Pearce  
Telephone: (213) 244-2269

Southern California Edison Company  
Mr. Bob Patterson  
Telephone: (909) 930-8432

Santa Ana Watershed Project Authority (For SARI sewer)  
Mr. Lee Slate  
Telephone (909) 354-4220

#### 1.8.5.2 Telephone Lines

The Contractor shall notify, 60 calendar days prior to permanent installation of all telephone lines.

#### 1.8.5.3 Contractor Shall Notify the Contracting Officer

The Contractor shall notify the Contracting Officer, in writing, not less than 14 days in advance of the date on which he will complete trenching, excavation, fill or rough grading, as applicable, at each location where such completed work is required for temporary or permanent relocations by others. The Contractor shall allow a period of 14 calendar days at each relocation, after which time the Contractor may resume his operations.

#### 1.8.5.4 Existing Bench Marks and R/W Markers

The Contractor shall notify the Contracting Officer, in writing, 7 days in advance of the time he proposes to remove any bench mark or right-of-way marker.

#### 1.8.5.5 Spill Reporting

The Contractor shall notify the Contracting Officer immediately after all spills, regardless of quantity, including all personnel exposures. The Contractor shall submit a written notification not later than 7 calendar days after the initial notification. The written notification shall include the following:

- a. Item spilled, leaked or releases in an unauthorized manner (Identification, Quantity and Manifest Numbers).
- b. Whether the amount spilled, leaked or released in an unauthorized manner is EPA reportable and, if reported, a copy of the report.
- c. Exact location of the spill, leak or unauthorized release.
- d. Nature of exposure to personnel.
- e. Containment procedures initiated.
- f. Anticipated cleanup and disposal procedures.
- g. Disposal location of spill, leak or unauthorized release residue.

#### 1.8.6 Restrictions

##### 1.8.6.1 Representatives of Other Agencies

Personnel representing owners and agencies may be present for various portions of the work. However, the Contractor will be responsible only to the Contracting Officer.

##### 1.8.6.2 Working Hours

The Contractor shall restrict all construction activities, including warming equipment, to the following schedule:

Monday through Friday	7 a.m. to 7 p.m.
Saturday	9 a.m. to 6 p.m.

Access to the job site will be allowed 30 minutes prior to starting time unless otherwise approved by the Contracting Officer. No work will be permitted on Sundays or Federal Holidays.

#### 1.8.6.3 Water for Construction

Reference is made to the clause of the contract entitled "Permits and Responsibilities," which obligates the Contractor to obtain all required licenses and permits for construction, including water for construction. The Contractor shall be responsible for obtaining and paying all costs and fees associated with the acquisition of water for construction. Water rights within the Prado Basin are owned by the Orange County Water District (OCWD). The Contractor shall not intercept existing surface or subsurface flows at any time during the contract performance period. All water from dewatering shall be returned to the streambed. Additionally, water from the water well shown on the drawings to be constructed by this contract can not be used by Contractor for any purpose.

### 1.9 ROADS AND CULVERTS

#### 1.9.1 Existing Roads

The work shall be planned in such a manner that traffic on the existing roads outside the actual construction areas shall be maintained at all times. Maintenance shall be as specified in paragraph: Maintenance of Roads. The work area shall be examined carefully relative to the order and scope of work to be performed, with respect to the limiting provisions of the plans and specifications. Additional work on the existing roads may be done by others during the life of this contract.

##### 1.9.1.1 Existing Sound Walls

The Contractor is responsible for maintaining required noise levels as stated in 01410 ENVIRONMENTAL PROTECTION.

#### 1.9.2 Temporary Access and Haul Roads

Plans shall be submitted for approval on all proposed access and haul roads and all deviations, whether within or outside the limits of the construction area, at least fifteen (15) calendar days prior to construction of such roads. The plans shall indicate width of road, direction of traffic, road markings, type of guardrail, curves, grades, runouts, and other information in sufficient detail for studying safety of the proposed roads. The plans shall include details for removal and obliteration of haul roads and temporary access roads and restoration of the area as specified in paragraph: Post-Construction Cleanup and Obliteration.

##### 1.9.2.1 Haul Road Design References

Design of haul roads shall meet or exceed the requirements of the Corps of Engineers Safety and Health Requirement Manual, Section 30.D (EM 385-1-1). An applicable design guide is the Surface Mine Haulage Road Design Study by Skelly and Loy of Harrisburg, PA, prepared for the Bureau of Mines, Washington, DC, dated June 1976.

##### 1.9.2.2 Haul Road Design

Roads shall be designed for the type of vehicles in use. The maximum sustained grade shall not exceed 10% with an absolute maximum grade of 15% for a distance not to exceed 200 linear feet. Each lane of travel shall provide clearance that is equal to one-half of the widest vehicle in use (a 12 ft. wide vehicle will require a 24 ft. travel lane). The minimum horizontal curve radius shall not be less than 25 ft. on the inside of the curve. Vertical curves shall be a minimum of 100 ft. and be designed with consideration of the change in grades, height of the driver's eyes, height of an object a minimum of 6 inches above the road surface, and required stopping distance. Curve widening, proper cross slopes and superelevations shall be provided as necessary. Road ditches and culverts shall be included to control surface drainage away from erodible areas. Culverts shall be provided along natural water courses intersected by the haul road fill and shall be maintained as specified in paragraph: Culverts. Design shall also include provisions to control runaway vehicles on steep grades such as an escape lane. Design shall be subject to the Contracting Officer's approval.

#### 1.9.3 Public and Private Access Roads

When it is necessary for heavy equipment to operate on or to cross project roads or arterial roads, flaggers, signs, lights, and/or other necessary safeguards shall be furnished to safely control and direct the flow of traffic. When it is necessary to operate on existing roads outside the construction area, all necessary permits shall be obtained from the appropriate private or public authority. Work shall be conducted in such manner so as to obstruct and inconvenience traffic on existing roads outside the construction limits as little as possible. Spillage of earth, dusty materials, boulders, and mud on project roads or other roads shall not be permitted. If spillage cannot be prevented, the spillage shall be immediately removed and such areas shall be kept clear throughout the workday. At the conclusion of each workday, such traveled areas shall be cleared of spillage, boulders, and mud.

#### 1.9.4 Maintenance of Roads

All roads shall be maintained regularly to provide vehicular access for the Government's vehicles and the Contractor's vehicles and equipment during the contract performance period. Road maintenance shall include: clearing and disposal of rock/mud slides on the roads and drainage ditches, repair of washouts, repair of potholes and ruts, regrading, and any incident which would restrict vehicular/equipment access. Prior to any alterations of any road alignment the Contractor shall receive approval from the Contracting Officer. Road maintenance and alterations shall be performed by the Contractor at no additional cost to the Government.

#### 1.9.5 Temporary Culverts

Culverts shall be provided as required for road drainage. Culverts shall be corrugated metal pipe of adequate diameter. Dump stone or other energy dissipating structures shall be provided at all outlets of culverts to prevent undermining of pipe. Exact locations of the culverts shall be subject to approval by the Contracting Officer.

##### 1.9.5.1 Culvert Maintenance

All culverts within the construction area, including the borrow areas, shall be maintained to provide unrestricted flow through the culverts. Culvert maintenance shall include debris cleaning, repair of failures, and

extension of culverts due to road alterations. Culvert maintenance shall be performed by the Contractor at no additional cost to the Government.

#### 1.10 TRAFFIC SAFETY

##### 1.10.1 Warning Devices

In accordance with Contract Clause ACCIDENT PREVENTION, signs, barricades, and warning devices shall be provided, installed, and maintained as are required for protection of vehicular traffic at any location where operations interfere with public or private roads. Signs, barricades, lights, and signals shall be in conformance with Part VI of the U.S. Department of Transportation Manual on Uniform Traffic Control Devices for Streets and Highways.

##### 1.10.2 Rock and Gravel

Rock and gravel for use on haul roads and other facilities may be obtained from any source within the excavation limits or stockpiles within the project boundaries not designated for other use. The use of any such source shall be subject to approval by the Contracting Officer.

#### 1.11 WATER CONTAMINATION

In order to prevent contamination of water along waterways, all refuse, oil, greases, and other petroleum products; all toxic materials; all cement or concrete; or water containing such materials shall be disposed of in a manner to prevent their entry into the water along waterways.

#### 1.12 SCRAP MATERIAL

Materials indicated to be removed and not indicated to be salvaged, stored or reinstalled are designated as scrap and shall become the property of the Contractor and be removed from the site of work. The Contractor by signing this contract hereby acknowledges that he made due allowance for value, if any, of such scrap in the contract price.

#### 1.13 ARCHAEOLOGICAL FINDINGS DURING CONSTRUCTION

Should the Contractor or any of his employees in the performance of this contract find or uncover any archaeological remains, he shall notify the Project Engineer immediately. Such notification will be a brief statement in writing giving the location and nature of the findings. Should the discovery site require archaeological studies resulting in delays and/or additional work, the Contractor will be compensated by an equitable adjustment under the General Provisions of the contract.

#### 1.14 POST-CONSTRUCTION CLEANUP AND OBLITERATION

The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, access roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction as directed by the Contracting Officer. Excavation, filling, regrading and plowing of roadways and other construction areas will require the areas to be restored to near natural conditions, which will permit the growth of vegetation thereon. The disturbed areas shall be graded and filled as required, and the areas scarified prior to placement of soil covering for hydroseeding.

## 1.15 PERMITS

### 1.15.1 General

Reference is made to the clause of the contract entitled "Permits and Responsibilities," which obligates the Contractor to obtain all required licenses and permits, including, but not necessarily limited to the following specified hereinbelow.

#### 1.15.1.1 National Pollutant Discharge Elimination System (NPDES) Permit

The project requires an NPDES permit from the California State Water Resources Control Board, Division of Water Quality. The general permit requires development and implementation of Storm Water Pollution Prevention Plan (SWPPP) , which shall be maintained on-site throughout the construction period. Contractor shall comply with the requirements of SECTION 01356: STORM WATER POLLUTION PREVENTION MEASURES. Modifications to the plan as necessary to reflect Contractor's construction methods shall be submitted by the Contractor to the Government for approval.

#### 1.15.2 Encroachment Permit and Traffic Detour Plan

The project has been designed to avoid construction on the shoulder and traveled way of the State Route 71. The Contractor is responsible for obtaining all permits for work on or around the SR 71 roadway. Information for an encroachment permit to implement a closure of the highway shoulder can be obtained at:

Office of Permits  
Department of Transportation  
464 W. Fourth Street, 6th Floor, MS 619  
San Bernardino, CA 92401-1400  
(909) 383-4536

Information for a traffic detour plan can be obtained at:

Operations Division  
Department of Transportation  
464 W. Fourth Street, 6th Floor, MS 619  
San Bernardino, CA 92401-1400  
(909) 383-5979

## 1.16 REQUIRED INSURANCE

### 1.16.1 General

The Contractor shall maintain insurance in full force and effect throughout the term of this contract. The policy or policies of insurance maintained by the Contractor shall provide the limits and coverages as set forth herein below.

#### 1.16.2 Insurance

Insurance shall be in force the first day of the term of this contract.

#### 1.16.3 Insurance Policy

Each insurance policy required by this contract shall contain the following three clauses:

- a. "This insurance shall not be canceled, limited in scope of coverage or non-renewed until after 30 days written notice has been given to (1) Riverside County Flood Control and Water Conservation District, Attn: Steve Thomas, 1995 Market Street, P.O. Box 1033, Riverside, CA 92502-1033, (2) San Bernardino County Flood Control District, Attn: Vana Olsen, 825 East Third Street, San Bernardino, CA 92415-0835, and (3) Orange County Public Facilities and Resources Department, Attn: Herb Nakasone, 300 North Flower Street., P.O. Box 4048, Santa Ana, CA 92702-4048.
- b. "All rights of subrogation are hereby waived against the County of Riverside, San Bernardino, and Orange and the members of the Board of Supervisors and elective or appointive officers or employees, when acting within the scope of their employment or appointment, and County Districts and their Board or Commissions which are governed by the County Board of Supervisors".
- c. "As respects operation of the named insured performed on behalf of the Government, the following are added as additional insureds:
  - 1. The San Bernardino County Flood Control District, County of San Bernardino, Orange County Public Facilities and Resources Department, County of Orange, Riverside County Flood Control and Water Conservation District, and the County of Riverside.
- d. "It is agreed that any insurance maintained by the Orange County Public Facilities and Resources Department, and the County of Orange will apply in excess of, and not contribute with, insurance provided by this policy.

LIABILITY INSURANCE

COVERAGE	MINIMUM LIMITS
Comprehensive General Liability single limit including Completed Operation and a Broad Form Property Endorsement and Comprehensive Automobile Liability	\$10,000,000 combined  per occurrence.
Worker's Compensation	Statutory

1.16.4 Liability Insurance

Any liability insurance required by this contract shall not contain exclusions or endorsements which eliminate or limit coverage for the following:

- a. Claims of liability for bodily injury or property damage caused by, resulting from, attributable or contributed to, or aggravated by the subsidence or other movement of soils or land as a result of landslide, consolidation, expansion, creep, shifting, sinking, or mud flow;
- b. Claims of liability for bodily injury or property damage caused by, resulting from, attributable or contributed to, or aggravated by the actual, alleged, or threatened discharge, dispersal,

- release or escape of any pollutants;
- c. Completed Operations coverage;
- d. Products coverage;
- e. Broad Form Property Damage coverage;
- f. Blanket Contractual coverage.

#### 1.16.5 Fire and Extended Coverage

The Contractor shall purchase a course of construction property insurance policy to cover structures (excluding reinforced concrete structures) being built under the terms of this contract to at least 90 percent of their replacement cost. As a minimum, coverage shall be provided for replacement cost and for fire and the extended coverage perils.

#### 1.16.6 Worker's Compensation

Each liability and worker's compensation insurance policy required by this contract shall contain clause numbers 12.3 (a.) and 12.3 (c.) above, and the following clause: "It is agreed that any insurance maintained by the County of Riverside, San Bernardino, and Orange will apply in excess of, and not contribute with, insurance provided by this policy."

##### 1.16.6.1 Procuring of Required Policy

The procuring of such required policy or policies of insurance shall not be construed to limit Contractor's liability hereunder not to fulfill the indemnification provisions and requirements of this contract.

##### 1.16.6.2 Contractor Agrees to Indemnify

Contractor agrees to indemnify and save harmless agency, its officers, employees, agents and volunteers from and against any and all claims, actions, losses, damages and/or liability arising out of this contract from any cause whatsoever, including the acts, errors or omissions of any person, except where such indemnification is prohibited by law.

#### 1.17 PROGRESS PAYMENTS

##### 1.17.1 Partial Pay Estimates

Partial pay estimates shall be submitted every month. The following items shall be submitted with the partial pay estimates to ensure prompt payment:

- a. Project schedule Narrative and Earnings Monthly update reports as specified in Section 01320 PROJECT SCHEDULE, paragraph: Contractor Prepared Network Analysis System (NAS).
- b. Safety report(s) in accordance with OSHA, CALOSHA, and the Corps of Engineers' EM 385-1-1.
- c. Updated/current submittal register as specified in Section 01330 SUBMITTAL PROCEDURES, paragraph: Submittal Register (ENG FORM 4288).
- d. Quality Control Reports as specified in Section 01451 CONTRACTOR

QUALITY CONTROL, paragraph: Documentation.

- e. Updated forecasting of expenditure worksheets as specified in the paragraph below

#### 1.17.2 Forecasting of Future Progress Payments

By July 15th of each year, the Contractor shall give the Contracting Officer the projected monthly earnings for the upcoming fiscal year (fiscal year begins in November). The Contracting Officer will provide a spreadsheet to the Contractor showing the different funding categories and their respective percentages for each bid item for the total contract amount after the issuance of notice to proceed (See attached FIGURE 5). Similar accounting information will be contained in any subsequent contract modification issued for this contract. Each pay period the Contractor shall forecast his expenditures for the following 3 pay periods, indicating the funding requirement for each accounting category. The updated worksheet (see FIGURE 6) shall be submitted with each partial pay estimate (e.g., submittal for partial pay estimate for the period of 15 DEC to 15 JAN will include a forecast of expenditures for the period of 15 JAN to 15 APR). Forecasting of expenditures is needed to assure sufficient funding for future progress payments. If the contractor's actual earnings for any particular partial pay estimate exceed the funding available for payment due to inaccurate submittal of forecast expenditures, the contracting office can reject the contractor's invoice as defective, and require the contractor to resubmit the invoice of an amount not exceeding the previously submitted forecast amounts.

#### 1.18 NOTICE OF PARTNERSHIP

The Government intends to encourage the foundation of a cohesive partnership with the Contractor and its subcontractors. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objectives are effective and efficient contract performance and intended to achieve completion within budget, on schedule, and in accordance with plans and specifications; and to develop a single cooperative management team focused on the success of the project to mutual benefit of all stakeholders. This partnership would be bilateral in makeup, and participation will be totally voluntary. Any cost associated with effectuating this partnership will be agreed to by both parties and will be shared equally with no change in contract price. An integral aspect of partnering is the resolution of disputes in a timely, professional, and non-adversarial manner through the use of issue clarification and problem solving. Alternate Dispute Resolution (ADR) methodologies will be encouraged in place of more formal dispute resolution procedures. ADR will assist in promoting and maintaining an amicable working relationship to preserve the partnership. ADR is a voluntary, nonbinding procedure available for use by the parties to this contract to resolve any dispute that may arise during performance. To implement this partnership initiative it is anticipated that within 60 days of Notice to Proceed the Contractor's on-site project manager and the Government's Resident Engineer would attend a two day partnership development seminar/team building workshop together with the Contractor's key on-site staff and key Government personnel. Follow-up workshops of 1 to 2 days duration would be held periodically throughout the duration of the contract as agreed to by the Contractor and Government.

#### 1.19 ALTERNATIVE DISPUTES REVIEW PROCESS

In order to assist in the resolution of disputes or claims arising out of this project, this contract clause establishes an Alternative Disputes Review process. A Disputes Review Board will, by mutual agreement of the parties and in accordance with this clause, be established but is not intended to be a substitute for normal negotiated Government and Contractor dispute resolution. The parties shall establish the Board within 90 calendar days after the Notice to Proceed as set forth in Attachment 1. The Disputes Review Board will consider disputes referred to it and will provide non-binding recommendations to assist in the resolution of the differences between the Government and Contractor. The following alternative procedure may be used for dispute resolution. Specific procedures to be followed for disputes referred to the Disputes Review Board are set forth as attachments to this provision.

If the Contractor objects to any oral decision or order of the Contracting Officer or his Authorized Representative(s), the Contractor shall request in writing a written decision or order from the Government. Such request is not considered a dispute for purposes of the Contract Disputes Act.

After receipt of the Government's written decision or order the Contractor shall, if there is an objection to such decision or order, file a written protest with the Government, stating clearly and in detail the basis of the objection. The Government will consider any written protest and make a decision within 15 days from receipt of the written protest either agreeing or disagreeing with the protest. If there is not complete agreement, the matter can either be referred to the Disputes Review Board by mutual agreement of the Government and the Contractor, or the Contractor may request that the Contracting Officer issue a final decision on the matter, from which the contractor may pursue an appeal in accordance with the "Disputes" clause of the contract.

In the event the Government and the Contractor mutually agree to submit the dispute to the Disputes Review Board, the request for review must be instituted within 30 days of the date of receipt of the Government's last decision. Pending review by the Disputes Review Board of a dispute, the Contractor shall diligently proceed with the work as previously directed.

The Contractor and the Government shall each be afforded an opportunity to be heard by the Disputes Review Board and to offer evidence. The Disputes Review Board recommendations toward resolution of a dispute will be given in writing to both the Government and the Contractor within 30 days following conclusion of the proceedings before the Disputes Review Board.

Within 30 days of receiving the Dispute Review Board's recommendations, both the Government and the Contractor shall respond to the other in writing signifying that the dispute is either resolved or remains unresolved. If the Government and the Contractor are able to resolve their dispute, the Government will expeditiously process any required contract modifications. Should the dispute remain unresolved after 30 days following receipt of the Board's recommendations, the Contractor may submit a request for a Contracting Officer's decision under the "Disputes" clause of the contract.

The attached information at the end of this section forms a part of this Special Clause. The Alternative Disputes Review Process (Attachment 1) describes the purpose and function of the Disputes Review Board. The Disputes Review Board Three Party Agreement which sets out the terms between the parties (Attachment 2) must be completed and signed by both parties in accordance with the conditions in that Agreement. The Contract

Disputes Review Board Guidelines (Attachment 3) set forth the objective and responsibility of the Disputes Review Board. These attachments set out all the guidelines for this Special Clause providing an alternative disputes review process.

## 1.20 AVAILABILITY OF ADDITIONAL INFORMATION

### 1.20.1 Documentation and Reports

Additional design information and data are available through the Contracting Officer. Specific information available for review include: the Phase II GDM on the Santa Ana River Mainstem - Main Report & Supplemental Environmental Impact Statement, dated August 1988; the Supplemental Final Environmental Impact Statement/Environmental Impact Report for Prado Basin and Vicinity dated November 2001; the Draft Feature Design Memorandum No. 12 Prado Dam Outlet Works; selected as-built drawings from 1938 through 1940; pump test data, and groundwater data. It is emphasized that significant changes have been incorporated into the Plans and Specifications from the designs proposed in the design memorandums. The design memorandums and other data are available for information purposes only and are not a part of the contract documents since they have been superseded by the Plans and Specifications.

### 1.20.2 Field Investigations

Prior to bid opening, the Contractor may make arrangements to access the site to perform geotechnical investigations on the following conditions:

Coordinate with the Prado Resident Office, Fernando Cano or Bob Garda, 48 hours in advance for access to the site. Access would be limited to standard work hours, Monday through Friday. Submit a hazard analysis and layout of proposed work to the Prado Resident Office for approval prior to commencement of any work.

A Corps of Engineers geologist or one of his representatives will observe the investigations. Contractor shall notify POC Dave Lukesh, (213) 452-3577, 72 hours in advance.

Notify the Corps' Cultural Resources Specialist, Stephen Dibble, (213) 452-3849, 48 hours prior to commencing investigations.

Activities shall not take place or interfere with Endangered Species in standing water or other sensitive locations. As long as the proposed activities occur outside of the active stream channel, and outside of vireo nesting season (which begins March 1), that should satisfy most environmental concerns.

Standard requirements concerning equipment use must also be met (i.e., equipment must be properly tuned and maintained to minimize air pollution, avoid leaks/contamination of soil and groundwater, don't refuel within the river channel, etc.).

Corps Safety Standards EM-385-1-1 shall apply.

### 1.21 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the Contract Clause entitled: DEFAULT (FIXED PRICE CONSTRUCTION). In order for the Contracting

Officer to award a time extension under this clause, the following conditions must be satisfied:

(a) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipation for the project location during any given month.

(b) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

#### 1.21.1 Anticipated Adverse Weather Days

The following schedule of monthly anticipated adverse weather delays 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. Adverse Weather Days were determined based on the following 3 elements:

- a. Daily Precipitation  $\geq$  .10 inch
- b. Max. Daily Temperature  $\geq$  100 degrees F
- c. Min. Daily Temperature  $\leq$  32 degrees F

#### MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS BASED ON FIVE (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	4	3	1	1	3	7	6	4	2	2	4

#### 1.21.2 Documentation

Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actually adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled work day. The number of actual adverse weather days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day 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 the subparagraph 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).

#### 1.22 Visitor Center Trailer

Visitor's Center Trailer (12' X 60'). The contractor shall provide a new 12' X 60' visitor's trailer in the Corps of Engineers Santa Ana Dams Resident Office located at 2493 Pomona-Rincon Rd. Corona, CA. The trailer shall be installed with appropriate hold-downs and finished with appropriate skirting around the perimeter of the trailer. The trailer color scheme shall match the existing office colors. The contractor shall provide a covered deck 8 feet wide by 60 feet long along west side of the trailer. The deck shall include appropriate railing, stairs and

handicapped ramp. The trailer shall be adequately heated well lighted, suitable ventilated and cooled with properly sized air-conditioned unit. The contractor shall provide a handicapped accessible water-cooled drinking fountain with an inline replaceable water filter. The drinking fountain can be located adjacent to the toilets. Sewer, permanent water supply, telephone and electrical service shall be provided and maintained. Data line and Telephone line shall be provided in the office. Telephone and Data lines for the computer shall be tied to the existing system. Materials for the facility shall be new. It is estimated that the trailer requires a 100amp 120/240-volt service.

The trailer shall have two 5' x 6' handicapped accessible bathrooms consisting of a water closet, sink and related items. The trailer shall also have an office 8' X 8' office space located on the middle of the trailer along the 60' length of the trailer. The side of the trailer opposite where the bathrooms are located shall not be equipped with windows. The office wall facing the side of the trailer with no windows shall be equipped with a 12" X 12" opening and a 8" ledge. The trailer shall be divided at the center with a partition wall and office. A handicap accessible door is to be installed in the partition wall to access the other half of the building.

Five pack lights are to be installed for the parking area. Two Pac halogen lights are to be installed on the existing Lab Office along the 60' length and face the parking area. Two Pac halogen lights are to be installed on the new covered walkway for the visitor center and face the parking area. One Pac halogen light is to be installed on the southwest corner of the visitor center trailer. All of the Pac lights are to be activated with a solar censor.

The trailer is to be installed adjacent to the existing library building and as close to it as possible. The Contractor is to hook up to the utilities, which have been terminated below the library building. The visitor's trailer is to have all handicapped accessible entrances and exits. Trailer is to be equipped with security bars and doors. The trailer shall fall under the maintenance requirement of the existing office. The contractor is to provide new commercial grade furniture consisting of twelve slip based armed guest chairs type, colors to match the existing chairs in the main office. The contractor shall submit a visitors office layout plan for approval.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

## ALTERNATIVE DISPUTES REVIEW PROCESS - ATTACHMENT 1

## DISPUTES REVIEW BOARD

## 1. Purpose.

The Disputes Review Board is an advisory body which may be created by mutual agreement of the Government and the Contractor for a particular construction project. The Board's function will be to assist in the resolution of claims, disputes or controversy between the Contractor and the Government. Any recommendations made by the Board will be advisory, and will not be binding upon either party.

## 2. General.

a. Definition. The Disputes Review Board process is a voluntary, expedited procedure, whereby an independent three-party Board is established to evaluate contract disputes and provide recommendations to the Government and its Contractor with the objective of resolving disputes.

b. The Board will consider disputes referred to it, and will furnish recommendations to the Government and Contractor to assist in the resolution of the differences between them. The Board will provide technical expertise to assist and facilitate the resolution of disputes.

## 3. Board Membership.

a. The Disputes Review Board shall consist of three individuals respected in the field of engineering for their ability and integrity, who are experienced with the processes anticipated to be used to construct the project: one member shall be selected by the Government; one member shall be selected by the Contractor; and, one member shall be selected by these first two members. The first two members shall be mutually acceptable to both the Government and the Contractor. If the two parties are unable to agree on these first two members, the mutual decision to submit disputes to a Disputes Review Board shall be considered terminated.

b. The two members acceptable to the Government and the Contractor will independently select the third member. If the two members are unable to select an acceptable third member, the decision to submit disputes to a Disputes Review Board shall be considered terminated.

c. No member shall have a financial interest in the contract, except for payment for services on the Disputes Review Board. Except for fee-based consulting services on other projects, no Board member shall have been employed by either party within a period of two years prior to award of the contract. No member shall have had substantial prior involvement in the project that could compromise his ability to impartially participate in the Board's activities.

## 4. Selection of the Disputes Review Board Procedure.

If the parties mutually agree that a Disputes Review Board should be established for work performed under a contract, the Government and the Contractor shall negotiate an agreement with their member within 60 calendar days after execution of the contract. The selection of the Disputes Review Board Alternative Disputes Review procedure for resolution of contract disputes shall be void if the two members are unable to select a third member

within 30 calendar days.

5. Procedure for Submitting Dispute to the Board.

a. If the Contractor objects to any oral decision or order of the Contracting Officer or his Authorized Representative(s), the Contractor shall request in writing a written decision or order from the Government.

b. After receipt of the Government's written decision or order the Contractor shall, if there is an objection to such decision or order, file a written protest with the Government, stating clearly and in detail the basis of the objection. The Government will consider any written protest and make a decision within 15 days from receipt of the written protest either agreeing or disagreeing with the protest. If there is not complete agreement, the matter can either be referred to the Disputes Review Board by mutual agreement of the Government and the Contractor, or the Contractor may request that the Contracting Officer issue a final decision on the matter, from which the Contractor may pursue an appeal in accordance with the "Disputes" clause of the contract.

c. In the event the Government and Contractor mutually agree to submit the dispute to the Disputes Review Board, the request for review must be instituted within 30 days of the date of receipt of the Government's last decision. Pending review of the Disputes Review Board of a dispute, the Contractor shall diligently proceed with the work as previously directed.

d. The Contractor and the Government shall each be afforded an opportunity to be heard by the Disputes Review Board and to offer evidence. The Disputes Review Board shall submit in writing recommendations towards factual (as opposed to legal) resolution of a dispute to both the Government and the Contractor within 30 days following conclusion of the proceedings before the Disputes Review Board.

e. Within 30 days of receiving the Dispute Review Board's factual recommendations, both the Government and the Contractor shall respond to the other in writing signifying that the dispute is either resolved or remains unresolved. If the Government and the Contractor are able to resolve their dispute, the Government will expeditiously process any required contract modifications. Failure of either party to respond within 30 days following the receipt of the Board's recommendations will be deemed acceptance of the Board's recommendations.

f. In appropriate cases the Contractor and the Government may agree that a dispute should be submitted to the Disputes Review Board, but that the dispute only warrants the efforts of one Board Member. In such cases the third Board Member will mediate the dispute without participation of the other two members. Other than submitting the dispute to only the third Board Member, the procedural requirements of the Alternative Disputes Review Board Process as set forth in paragraph 7a-e above will be followed.

6. Board Procedures.

a. The Disputes Review Board will formulate its own rules of operation. In order to keep abreast of construction progress, it is recommended that the members, as a Board, will visit the project at least quarterly, keep a current file and regularly meet with representatives of the Government and the Contractor. More frequent than quarterly site visits shall be as agreed between the Government, the Contractor and the Board. The Board should take these opportunities to make recommendations to either or

both, the Government and the Contractor to facilitate the construction and/or prevent problems from occurring.

b. Should the need arise to appoint a replacement Board member, the replacement member shall be appointed in the same manner as the original Board members were appointed. The selection of a replacement Board member shall begin promptly upon notification of the necessity for a replacement, and shall be completed within 30 calendar days. The Disputes Board Three Party Agreement will be supplemented to indicate changes in Board membership.

c. For further description of work, responsibilities and duties of the Disputes Review Board, and the Government and Contractor's obligations and responsibilities with respect to each other and to the Disputes Review Board, see the "Disputes Board Three Party Agreement" as set forth in attachment 2.

#### 7. Expenses of the Board and Board Members.

Compensation for the Disputes Review Board members, and the expenses of operation of the Board, shall be shared by the Government and Contractor in accordance with the following:

a. The fees and expenses of all three members of the DRB shall be shared equally by the Government and the Contractor. The Contractor shall pay the invoices of all DRB members after approval by both parties. The Government shall reimburse the Contractor for one half of the approved invoices.

b. The Government at its expense will provide administrative services, such as conference facilities and secretarial services, to the Board.

#### 8. Three Party Agreement.

a. The Contractor, the Government and all three members of the Board shall execute the "Disputes Review Board Three Party Agreement" within 30 calendar days following the final selection of the third member.

b. The "Disputes Review Board Three Party Agreement" and the "Contract Disputes Review Board Guidelines" to said Agreement are set forth in attachments 2 and 3.

## ALTERNATIVES DISPUTES REVIEW PROCESS - ATTACHMENT 2

## THREE PARTY AGREEMENT

THIS THREE PARTY AGREEMENT, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, 200\_, between: The United States Army Corps of Engineers, acting through the Contracting Officer of the U.S. Army Engineer District, Los Angeles, hereinafter called the CORPS; the \_\_\_\_\_ company, hereinafter called the "CONTRACTOR," and the Disputes Review Board, hereinafter called the "BOARD" consisting of three members; \_\_\_\_\_; \_\_\_\_\_, and \_\_\_\_\_.

WITNESSETH that,

WHEREAS, the CORPS and the CONTRACTOR are now engaged in the construction of the Prado Dam, Embankment, Outlet Works, and Appurtenances in Riverside County, California, under Contract No. DACW09-\_\_-B-\_\_\_\_; and

WHEREAS, the contract includes a provision authorizing, upon the mutual agreement of both the CORPS and the CONTRACTOR, the establishment and operation of a "Disputes Review Board" to assist in resolving disputes and claims; and

WHEREAS, the BOARD is composed of three members, one selected by the CORPS, one selected by the CONTRACTOR and the third member selected by these two;

NOW THEREFORE, in consideration of the terms, conditions, covenants and performance contained herein, or attached and incorporated and made a part hereof, the parties agree as follows:

## I.

## DESCRIPTION OF WORK

In order to assist upon mutual agreement by the CORPS and the CONTRACTOR in the resolution of disputes and claims between the CONTRACTOR and the CORPS, the contract provides for the establishment of a Disputes Review Board. The intent of the BOARD is to fairly and impartially consider any disputes mutually placed before it, and to provide written recommendations for resolution of such disputes to both the CORPS and the CONTRACTOR. The members of the BOARD shall perform all services necessary to participate in the BOARD's actions in accordance with the following Scope of Work.

## II.

## SCOPE OF WORK

The Scope of Work of the BOARD includes, but is not limited to, the following items of work.

## A. Procedures.

Prior to consideration of an appeal, the BOARD shall establish rules that will govern the conduct of its business, and reporting procedures based upon guidelines which are made a part of the Special Clause entitled, "ALTERNATIVE REVIEW DISPUTES PROCESS." The BOARD's factual recommendations, resulting from their consideration of a dispute or claim, shall be furnished

in writing to the CORPS and the CONTRACTOR. The recommendations shall be based on the pertinent contract provisions and facts and circumstances involved in the dispute.

B. Construction Site Visits.

The members as a BOARD shall visit the project site at least quarterly to keep abreast of construction activities and to develop a familiarity for the work in progress. More frequent site visits may be warranted. The frequency, exact time and duration of these visits shall be as mutually agreed between the CORPS, the CONTRACTOR and the BOARD. The Board should take these opportunities to make recommendations to either or both, the Government and the Contractor to facilitate the construction and/or prevent problems from occurring.

C. BOARD Consideration of a Dispute or Claim.

In the event of a claim or dispute, the CORPS and the CONTRACTOR may mutually agree to submit such claim or dispute to the BOARD. Upon receipt by the BOARD of a written claim or dispute, the BOARD shall convene to review and consider the matter. Both the CORPS and the CONTRACTOR shall be given the opportunity to present their evidence at these meetings. It is expressly understood that the BOARD members are to act impartially and independently in consideration of the contract provisions and the facts and conditions surrounding any written claim or dispute presented by the CORPS or the CONTRACTOR. The BOARD's factual recommendations concerning any such claim or dispute are advisory and non-binding upon both the CORPS and the CONTRACTOR.

D. Time and Place of Board Meetings.

The time and location of BOARD meetings shall be determined by the BOARD.

III.

CONTRACTOR RESPONSIBILITY

The CONTRACTOR shall furnish one copy of all pertinent documents it might have, other than those furnished by the CORPS, which are or may become pertinent to the performance of the BOARD. Pertinent documents are any drawings or sketches, calculations, procedures, schedules or estimates or other documents which are used in the performance of the work or in justifying or substantiating the Contractor's position.

IV.

CORPS RESPONSIBILITIES

The CORPS shall furnish the following services and items.

A. Contract Related Documents.

The CORPS Shall furnish the BOARD three copies of the Contract documents, change orders, written instructions issued by the CORPS to the Contractor or other documents pertinent to the performance of the contract and therefore, necessary to the BOARD's work.

B. Coordination and Services.

The CORPS Contracting Officer's Representative for the contract will, in cooperation with the CONTRACTOR, coordinate the operations of the BOARD. The CORPS, acting through the Contracting Officer's Representative, will arrange or provide conference facilities at or near the contract site and provide secretarial and copying services.

C. BOARD Cost Records.

The Board will maintain complete cost records, which will be available for inspection by either party. Shared expenses include the members' wages and travel expense, local lodging and subsistence for the BOARD members, and direct non-salary costs associated with BOARD operations.

V.

COMPENSATION

A. Payment for services of the CORPS and CONTRACTOR appointed members of the BOARD and the third appointed member will be at the rates agreed to between the CORPS and the CONTRACTOR (for the third appointed member) and between each of them and their respective appointed member.

Compensation, travel, and costs, for the BOARD members, and the expenses of operation of the BOARD, shall be shared by the CORPS and the CONTRACTOR in accordance with the following:

a. The CORPS and the CONTRACTOR shall share equally in the BOARD members' wages, expenses, and travel.

b. The CORPS and the CONTRACTOR shall share equally the other reasonable and necessary expenses of the BOARD.

B. Fee - Third Appointed Member.

Payment for services rendered by the third member of the BOARD shall not exceed the daily billing rate of \$\_\_\_\_\_, including travel time. This daily rate includes all direct labor costs, overhead and profit. Travel and subsistence expenses will be reimbursed at the actual cost, but shall not exceed the allowable amounts as provided by the Government's Joint Travel Regulations in effect at the time the expenses are incurred.

C. Direct Non-Salary Costs.

Direct non-salary costs of the BOARD will be reimbursed at the actual cost to the BOARD. These charges may include, but are not limited to; printing, long distance telephone calls, supplies, etc. The billing for non-salary costs, directly identifiable with the project, shall be an itemized listing to the charges supported by the original bills, invoices, expense accounts and miscellaneous supporting data retained by the BOARD members. Copies of the original supporting documents shall be supplied to the parties upon request.

D. Maximum Total Amount Payment.

The maximum total amount payable under this AGREEMENT for the BOARD's fee and travel costs, and the BOARD's direct non-salary costs, shall not exceed \$\_\_\_\_\_, unless a prior supplemental AGREEMENT has been negotiated and executed by the CORPS and the CONTRACTOR.

## E. Payments.

The BOARD may submit invoices to the CONTRACTOR for partial payment for work completed by the BOARD not more than once per month during the progress of the work. Such invoices shall be accompanied by a general description of activities performed during the billing period. The value of the work accomplished for partial payment shall be established by the billing from the BOARD members, and itemized direct non-salary costs incurred by the Board. The CONTRACTOR shall pay the invoices of the BOARD after approval by both parties. The CORPS shall reimburse the CONTRACTOR for one half of the approved invoices.

## F. Inspection of Cost Records.

The BOARD shall keep available for inspection by representatives of the CORPS for a period of three years after final payment the cost records and accounts pertaining to this AGREEMENT.

## VI.

## TERMINATION OF AGREEMENT

The parties of this AGREEMENT mutually agree that this AGREEMENT may be terminated at any time by written notice by the CORPS or CONTRACTOR to the other party. BOARD members may withdraw from the BOARD by providing notice. BOARD members may be terminated for cause only by their original appointor. Therefore, the CORPS may only terminate the CORPS appointed member, the CONTRACTOR may only terminate the CONTRACTOR appointed member, and the first two members must agree to terminate the third member.

## VII.

## LEGAL RELATIONS

The parties hereto mutually understand and agree that the third BOARD member in the performance of any duties on the BOARD is acting in the capacity of an independent Contractor and not as an employee of either the CORPS or the CONTRACTOR. The board members are absolved of any personal or professional liability arising from the activities and recommendations of the BOARD.

## VIII.

## DISPUTES

Any dispute between the parties hereto, arising out of the work or other terms of this AGREEMENT, which cannot be resolved by negotiation and mutual concurrence between the parties, shall render this AGREEMENT terminated.

## IX.

## GENERAL

## A. Notices.

All notices to be given herein shall be effective upon receipt and shall be in writing and personally delivered or mailed, first class,, postage

prepaid or given by telegram, facsimile or other similar means (followed by a confirmation by mail) to the parties. As the case may be, at the following address or such other address as may hereafter be designated, by the parties:

- a. If to the CORPS:  
Address to be provided.
- b. If to the Contractor:  
Address to be provided.
- c. If to the BOARD Members:  
Address to be provided.

B. Confidentiality.

No BOARD Member shall disclose to any person proprietary or confidential information of the CORPS or the Contractor, except as may be required by law.

In WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

BOARD MEMBER  
 By: \_\_\_\_\_  
 Title: \_\_\_\_\_

BOARD MEMBER  
 By: \_\_\_\_\_  
 Title: \_\_\_\_\_

BOARD MEMBER  
 By: \_\_\_\_\_  
 Title: \_\_\_\_\_

CONTRACTOR  
 By: \_\_\_\_\_  
 Title: \_\_\_\_\_

U.S. ARMY CORPS OF ENGINEERS  
 By: \_\_\_\_\_  
 Title: Contracting Officer

## ALTERNATIVE DISPUTES REVIEW PROCESS - ATTACHMENT 3

## CONTRACT DISPUTES REVIEW BOARD

## GUIDELINES

## I.

## OBJECTIVE

The principal objective of the Disputes Review Board (BOARD) is to provide technical advice to both parties that will assist in the resolution of disputes which would otherwise likely be resolved through the traditional litigative processes. If this objective is achieved, such disputes can be resolved promptly, with minimum expense, and with minimum disruption to the administration and performance of the work. It is not intended for the GOVERNMENT or the CONTRACTOR to default on their normal responsibility to amicably and fairly settle their differences by indiscriminately assigning disputes to the BOARD. It is intended that if mutually agreed to by the parties to constitute a Disputes Review Board for the purpose of attempting to resolve contract disputes, that the mere existence of the BOARD will encourage the CORPS and the CONTRACTOR to resolve potential disputes without the necessity of resorting to the formal appeal procedure under the "Disputes" clause of the contract.

## II.

## RESPONSIBILITY OF THE BOARD

A. The BOARD will provide technical advice and recommendations concerning controversy between the CONTRACTOR and the CORPS from construction arising under the contract. Primarily, the BOARD will consider interpretation of the plans and/or specifications, delays, acceleration of the work, scheduling, classification of extra work, changed conditions, design changes, and the like. During its regular visits to the job site, the BOARD will encourage the resolution of differences at the job level. The Board should take these opportunities to make recommendations to either or both, the Government and the Contractor to facilitate the construction and/or prevent problems from occurring.

B. During the period when the BOARD is in effect, other than by formal factual recommendations to both the CORPS and the CONTRACTOR, the BOARD will refrain from giving any advice or consultative services to either party. The BOARD members will act in a completely independent manner and will have no consultative or business connections with either party during their tenure as BOARD members.

C. Normally, the third BOARD member selected by the first two will act as Chairman for all activities. However, this may be delegated to another member from time to time.

## III.

## REGULAR CONSTRUCTION PROGRESS MEETINGS

A. All regular meetings will be held at or near the job site. Each meeting will consist of a round table discussion and a field inspection of the work being performed. The round table discussion will be conducted by a member of

the CORPS and will be attended by selected personnel from the CORPS and the CONTRACTOR. The agenda will generally be as follows:

1. Opening remarks by the CORPS Representative.
  2. A description by the CORPS of work accomplished since the last meeting, the current status of the work, schedule-wise, and a forecast for the coming period.
  3. An outline, by the CONTRACTOR, of potential problems and a description of proposed solutions.
  4. An outline by the CORPS' Contracting Officer, or his authorized representative, as to the status of the work as he views it including potential problems and proposed solutions.
  5. A brief description of potential claims or disputes which have surfaced since the last meeting.
  6. A summary of the status of past disputes and claims.
- B. The CORPS will prepare minutes of all regular meetings and circulate them for revision and/or approval by all concerned.
- C. The field inspection will cover all active segments of the work, the BOARD being accompanied by both the CORPS and CONTRACTOR personnel.
- D. The Board should take these opportunities to make recommendations to either or both, the Government and the Contractor to facilitate the construction and/or prevent problems from occurring.

#### IV.

##### HANDLING OF WRITTEN APPEALS

- A. When a written appeal is referred to the BOARD by either party, it shall first decide when to conduct a hearing. For an urgent matter the BOARD should convene at its earliest convenience. All hearings shall commence no later than 30 days following transmittal of a dispute to the BOARD.
- B. The BOARD may request that written documentation and arguments from both parties be sent to each individual member for study before the hearing begins.
- C. Normally, the hearing will last no more than 2 days, and would be conducted at the job site. However, any location which would be more convenient to all parties and still provide all required facilities and access to necessary documentation would be satisfactory.
- D. For hearings, the third member of the BOARD will act as Chairman, or he may appoint one of the other members. The CORPS and the CONTRACTOR shall have representatives at all hearings. The party initiating the dispute to the BOARD will discuss the dispute followed by the other party, each party being allowed equal time. Each party will then be allowed one or more rebuttals until all aspects are thoroughly covered. Each time a person testifies the BOARD members may ask questions, request clarification, or ask for further data. In large or complex cases more than two days of additional hearings may be necessary in order to consider all the evidence presented by both parties. However, no hearing on any single dispute will last for more

than 4 calendar days.

E. After the hearings are concluded, the BOARD shall meet in private and reach a conclusion supported by two or more members. Its factual (as opposed to legal) findings and recommendations, together with its reasons, shall then be submitted as a written report to both the CORPS and the CONTRACTOR within 30 days following completion of the hearings. The Board's recommendations shall be based on the pertinent contract provisions and facts and circumstances involved in the dispute.

F. The BOARD should make every effort to reach a unanimous decision. If this proves impossible, the dissenting member may prepare a minority report.

G. Although both parties should place weight upon the BOARD's recommendations, they are not binding. Either party may request the BOARD to reconsider its recommendation.

H. Position papers or other written material supplied to the BOARD are admissible in a subsequent proceeding unless the submitting party designates that they are submitted for settlement purposes only; in addition, any written report of the BOARD shall be admissible in such subsequent proceedings and each party hereby stipulates to its admissibility; and provided, further that if settlement is reached as a result of the recommendations of the BOARD, any material presented to the BOARD, as well as the recommended settlement, may be used to justify any contract modification which may result from the settlement.

I. It may not be necessary for the BOARD to keep a formal record of its sessions during the consideration of a dispute. This would depend partly upon the nature and magnitude of the dispute and upon the attitude of the parties.

V.

#### MISCELLANEOUS

It is not desirable to adopt hard and fast rules for the functioning of the BOARD. The entire procedure should be kept flexible so that it can adapt to changing situations. The BOARD should initiate, with the other parties' concurrence, new rules or modifications to old ones whenever this is deemed necessary. It is desirable to keep the hearings informal.

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## SECTION 01500

## QUALITY ASSURANCE

## 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 (1999b) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

## 1.2 QUALITY ASSURANCE TESTING PERSONNEL

The Contractor shall provide all necessary labor to perform quality assurance on-site sampling and laboratory testing. This is separate and in addition to those personnel the Contractor requires for his Quality Control testing requirements. The Contractor shall also provide a suitable number of foreman to act as liaisons between Government supervisors and Contractor's personnel performing quality assurance testing. The foreman shall be responsible for the productivity rates achieved by the technicians and laborers furnished by the Contractor.

## 1.2.1 Personnel

The Contractor shall continuously furnish a minimum of 1 supervisory laboratory technician, 2 laboratory technicians, and 1 laborer per work shift to perform sampling, testing, data reduction, surveying, volume calculations, and related work under the direct and exclusive supervision of the Contracting Officer for the duration of the contract. If this work force is inadequate, as determined by the Contractor's schedule, to perform all testing and quality assurance work as outlined in the paragraph: Minimum Quality Assurance Test Requirements, then the Contractor shall furnish additional personnel to accomplish this testing. The original acceptance and the continuing acceptability of all Contractor furnished personnel shall at all times be determined only by the Contracting Officer. The relationship existing between the Contractor and these personnel shall be free of coercion or other obligation to the Contractor, and from any conflict of interest, potential conflict of interest or duress as determined by the Contracting Officer. To ensure this end, the Contractor-furnished personnel cannot be terminated or transferred by the Contractor, after acceptance by the Contracting Officer, without just cause and without written permission of the Contracting Officer. The technicians shall each be laboratory testing specialists qualified to perform all sampling, testing and recording, interpreting test results and related work as required by the Government quality assurance program.

### 1.2.2 Qualifications

Each technicians shall have not less than two (2) years experience, satisfactory to the Contracting Officer, employed in testing laboratories established primarily for sampling, testing and control excavation and placement of soil materials as compacted fill. The supervising laboratory technician shall have 5 years of experience as outlined by ASTM D 3740 and ASTM C 1077 and shall be responsible for ensuring clean, well organized, and responsive testing operations, and prompt accurate test reports. Experience shall include demonstrable understanding and capabilities sufficient to perform all quality assurance and acceptance sampling and testing and related work.

### 1.2.3 Concrete Inspectors

The supervisory laboratory technician, laboratory technicians, and laborers participating in concrete inspection shall be certified to a minimum Level I Concrete Inspector as specified by the American Concrete Institute (ACI) or other equivalent licensing agency. They shall have a minimum of five years general experience in the practice of concrete inspection. They shall be currently licensed by the ACI or other approving agency for at least two years prior to their employment on the work described herein. Written certification of inspector qualifications, copies of certificates, and employment histories shall be submitted to and approved by the Contracting Officer at least 7 days prior to the commencement of any work requiring concrete inspection. Concrete inspection includes aggregate source development or sampling of materials by the Contractor; selection of sources of cements, pozzolans, and admixtures are not included in this requirement.

## 1.3 QUALITY ASSURANCE VEHICLES

The Contractor shall furnish **two (2)** vehicles for use by Government personnel during the contract period. **One vehicle shall be a new 7-passenger Chevrolet Blazer 4x4, or equal, and the second vehicle shall be a new 9-passenger Chevrolet Suburban 4x4, or equal, both** equipped with high floatation all terrain tires, automatic transmission, air conditioning, AM/FM radio, heavy duty suspension, and other appropriate options for use in heavy duty off road conditions. Each vehicle shall be equipped with a towing package, which shall include a hitch ball for a 2-inch ball coupler; heavy-duty flasher; automatic transmission cooler; safety chain; mirror for towing; and all weather ball and receiver tube covers. Each vehicle shall also be equipped with a steel shovel and a 5 lb. ABC type fire extinguisher, readily accessible to the driver. The vehicles shall be suitable for the intended purpose and shall remain the property of the Contractor and be removed from the site at the completion of the contract.

### 1.3.1 Delivery

The Contractor shall deliver the vehicles within thirty (30) days after receipt of the Notice to Proceed.

### 1.3.2 Licenses and Fees

The Contractor shall be responsible for all vehicles registration fees, licenses, and inspections required by the State of California throughout the contract period. The vehicles shall be licensed for highway use.

### 1.3.3 Maintenance

Upon delivery of the vehicles, and continuing throughout the duration of the contract, complete maintenance shall be provided for the Quality Assurance vehicles. Quality of services shall be to the normal standards of commercial service stations. Servicing and/or repairs of vehicles shall be started when the vehicle is received at the Contractor's service area and completed with reasonable promptness. Maintenance shall consist of the regular furnishing of gas and oil in the vehicle, washing, steam cleaning, lubrication consisting of 2,000-mile lube, 4,000-mile oil and filter change, or more if recommended by the vehicle manufacturer, tire services and any major or minor repair of body or fenders, transmission, rearend, engine, brakes, steering, front-end, radiator, etc. All necessary parts and supplies, and consumables shall be Contractor-furnished. The vehicles shall be washed and the interior of all vehicles shall be cleaned every week and the motor and undercarriage shall be steam cleaned as directed. Whenever gas or oil is furnished, windshields shall be washed, tires inflated to proper pressure, brake fluid level checked and filled if necessary, and the battery filled to proper levels. Gasoline and oil shall be of the quality recommended by the vehicle manufacturer. The Contractor may elect to contract with a local commercial service station and/or service garage in the immediate local vicinity of the damsite to provide these maintenance services, so long as all of the above required services can be provided. If more than 2 of the Contractor-furnished vehicles are being served at any particular time, the Contractor shall immediately provide a replacement vehicle of equal quality as a replacement. Maintenance shall also include the servicing of the 5 lb. fire extinguishers.

### 1.3.4 Storage of Vehicles

Open parking space for quality assurance vehicles shall be located convenient to the PradoDam Resident Office complex as approved by the Contracting Officer. The parking area shall be enclosed with a chain link fence approximately 6 feet high with a 10-foot wide lockable gate, accessible at all times. The fenced area shall be of sufficient size to permit ease in the parking of vehicles. Materials for fence and gate need not be new provided they area adequate for the intended use.

## 1.4 CONTRACTOR FURNISHED LABORATORY TESTING EQUIPMENT AND SUPPLIES

The Contractor shall procure and install equipment; supply and maintain testing laboratories for the exclusive use of the Contracting Officer for purposes of quality assurance/acceptance testing and data reduction. The laboratory buildings shall be equipped, supplied, and be operational within sixty (60) calendar days after receipt of Notice to Proceed. The Contracting Officer will use these facilities to perform government quality assurance laboratory tests, data acquisition, and activities deemed necessary by the Contracting Officer.

### 1.4.1 Calibration of Equipment

The Contractor shall be responsible for all testing equipment calibration. Calibration of testing equipment shall be performed as recommended by the manufacturer of the equipment, but in no case shall calibration be performed less often than annually.

### 1.4.2 Sources for Laboratory Testing Equipment

Catalogs of suppliers may be obtained from the following:

- (a) Soiltest, 86 Albrecht Drive, Lake Bluff, Illinois
- (b) Humboldt Mfg., 7300 W. Agatite Ave., Norridge, Illinois
- (c) California Hardware, 13085 E.Temple Ave., City of Industry, CA
- (d) Empire Scale Co., 301 South Los Angeles St., Los Angeles, CA

#### 1.5 CONCRETE TESTING EQUIPMENT

The following laboratory equipment shall be provided as part of the Test Laboratory facility for concrete tests. Unless otherwise noted, the catalog number indicated for the equipment is from Soiltest Inc (5th Edition). All equipment supplied shall be of the type and specifications provided from the catalog numbers listed. Alternate equipment may be supplied as approved by the Contracting Officer.

QUANTITY	CATALOG NUMBER	DESCRIPTION
4	EI34-6764	3'x2'x8' Concrete curing tanks Conforming to water storage requirements of ASTM C 511
4	EI34-6767/01	Cure tank heaters with circulating pumps
1	VF5-0114-2N	Fume Hood (4 ft.) VWR Scientific Co.
1	VF5-3301-B2	Blower moter for fume hood VWR Scientific Co.
1	VF5--114-A4	"Kemresin" top for fume hood VWR Scientific Co.
1	VFG-2088-00	Base cabinet for 4-ft. fume hood VWR Scientific Co.
1	N/A	Sufficient ducting to extend through the roof of laboratory building VWR Scientific Co.
100		5 gal plastic buckets w/lids
30 cases	EI34-5294	Plastic concrete cylinder molds (6 x 12 ) with lids 14A Industries
2	EI34-5295	Stripping tools
30 bags	EI34-6102	Capping compound, 50lb bag

#### 1.6 SOIL TESTING EQUIPMENT

The following laboratory equipment shall be provided as part of the Test Laboratory facility for soil tests. Unless otherwise noted, the catalog number indicated for the equipment is from Soiltest Inc (5th Edition). All equipment supplied shall be of the type and specifications provided from

the catalog numbers listed. Alternate equipment may be supplied as approved by the Contracting Officer.

QUANTITY	CATALOG NUMBER	DESCRIPTION
4 pair	EI88-7920	Hi-temp gloves
2	EI88-1040	2100 gram scale Ohaus Empire Scale Co.
36	29816329	Bicuit Pan California Hardware Co.
12	33002817	Plastic Pan California Hardware Co.
12	27840089	Roasting Pan California Hardware Co.
1	EI24-9095/12	Calibration Kit
1		Storage Container 10'x 10'x 20' with double wide doors
4	EI29-3739	Proving Ring Penetrometer

#### 1.7 SURVEY EQUIPMENT

Contractor shall provide one RTK system with two rovers for government personnel use. The system should be Leica GPS 500 system or equal, which includes a base station, two rovers, data collectors, pacific crest radios or equivalent, appropriate software to provide X-Y-Z points, and all necessary wiring and accessories. One base station can be used for the two rovers. The rovers shall be full RTK capable.

Contractor shall also provide a 32-hour training session, conducted by a certified factory trainer, consisting of field and class time. In addition, technical support shall be available as needed throughout the project.

The systems will be maintained by the Contractor throughout the duration of the contract and will become the property of the Contractor at the end of the contract. If one of the system components being serviced is out of service for more than 2 days, the Contractor shall immediately provide a replacement component of equal quality for the Government's use.

#### 1.8 CONSTRUCTION METHODS OBSERVATION

Any construction method, plant, or piece of equipment used on this contract shall not be considered proprietary, and can be inspected or photographed at any time by the Government, regulatory agencies, or any group approved by the Government.

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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 NATIONAL STANDARDS INSTITUTE (ANSI)

ASME B16.5 (1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24

ASME B31.1 (1998) Power Piping

## AGRICULTURAL MARKETING SERVICE (AMS)

AMS 3651 Current Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47 (1999) Ferritic Malleable Iron Castings

ASTM A 123 (2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 126 (1995) Gray Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A 240 (1995a) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

ASTM A 276 (1998) Stainless Steel Bars and Shapes

ASTM A 313 (1995a) Stainless Steel Spring Wire

ASTM B 16 Current Manual

ASTM B 32 (1996) Solder Metal

ASTM B 62 (1993) Composition Bronze or Ounce Metal Castings

ASTM B 88 (1999) Seamless Copper Water Tube

ASTM B 584 (1998a) Copper Alloy Sand Castings for General Applications

ASTM B 813 (2000) Liquid and Paste Fluxes for

	Soldering Applications of Copper and Copper Alloy Tube
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2133	Current Manual
ASTM D 2241	(1999a) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1999) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3308	(1997) PTFE Resin-Skived Tape
ASTM F 477	(1999) 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)
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## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
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## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1992; Addenda B301a - 1999) Liquid Chlorine
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C203	(1997; addenda C203a - 1999) Coal-Tar Protective Coatings and Linings for Steel

Water Pipelines - Enamel and Tape -  
Hot-Applied

AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C651	(1992) Disinfecting Water Mains
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C706	(1996) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

## ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA-01	(1988) Recommended Work Practices for A/C Pipe
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## FEDERAL SPECIFICATIONS (FS)

FS QQ-B-654	(Rev A; Am 1; Notice 1) Brazing Alloys, Silver
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NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS  
(NAPHCC)

NAPHCC-01	(1993; Supplement 1994) National Standard Plumbing Code (Non-Illustrated Edition)
NAPHCC-02	(1993) National Standard Plumbing Code (Illustrated Edition)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

## NSF INTERNATIONAL (NSF)

NSF Std 14	(1965; Rev Nov 1990) Plastics Piping System Components and Related Materials
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## 1.2 GENERAL REQUIREMENTS

Water supply and distribution system equipment shall be as indicated on the plans and as per these specifications. This specification shall provide for water distribution and connections to building service at a point approximately 5 feet 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 Supply Lines 3 Inches or Larger

Piping for buried water supply lines 3 inches or larger shall be polyvinyl chloride (PVC) plastic. Piping for water supply lines, and aboveground piping, less than 3-inch diameter shall be copper tubing. All piping systems shall be restrained by joint or concrete thrust or anchor block. Pipe through Control Tower Bridge shall be Schedule 80 PVC.

#### 1.2.2 Plastic Pipe

All plastic piping system components (PVC) intended for transportation of water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

#### 1.2.3 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

#### 1.2.4 Pipe 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. 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. PVC pipe shall not be stored in direct sunlight, or subjected to excessive direct sunlight, so as to cause damage. The Contracting Officer shall approve all PVC pipe installations, prior to backfilling the trench.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

- Pipe; G
- Fittings; G
- Joints; G
- Valves; G
- Couplings; G
- Valve boxes; G
- Water tanks; G
- Meters; G

Chlorinator; G

SD-05 Design Data

Design calculations of water piping and alignment; G

Waste Water Disposal Method; G.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation.

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.

Method for anchoring the water tank; G

The calculations shall propose a concrete slab dimension and anchorage system as shown on the plans.

SD-06 Test Reports

Bacteriological Disinfection; G.

Test results from commercial laboratory verifying disinfection.

SD-07 Certificates

Water tank; G

Pump control valve; G

Shop applied coating; G

Hydrostatic testing; G

The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified in all phases of PE, RTRP, and/or RPMP pipe laying and jointing and experienced to supervise the work and train the Contractor's field installers, prior to commencing installation.

SD-08 Manufacturer's Instructions

Installation

Installation procedures for water piping

The manufacturer's recommendations for each material or procedure to be utilized.

SD-10 Operation and Maintenance Data

Water Distribution System; G

Six Copies of Operation Manuals, which outline 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 a brief description of all equipment and their basic operation features. Six copies of 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; including, but not limited to well casings, submersible well pump, chlorination equipment, water storage tank, water system valves and piping, and electrical pump controller and related equipment.

#### 1.4 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to 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 in a satisfactory manner, at no additional cost to the Government. No other pipe or material 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 Coated and Wrapped Steel Pipe

Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

##### 1.4.2 Polyethylene (PE) Pipe Fittings and Accessories

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901.

##### 1.4.3 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

## 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 Polyvinyl Chloride (PVC) Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1785, Type 1 (normal imput), Grade 1 (high chemical resistance),

and is approved by the National Sanitation Foundation in sizes 1/4 inch through 12 inches for use in potabe water service. Pipe shall be schedule 40 with solvent welded joints, except as otherwise shown, or threaded or flanged. Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Solvent cement shall be in accordance with ASTM D 2564 and ASTM D 2855. Threaded couplings shall be stainless steel within the well casing.

#### 2.1.2 Copper Tubing

Copper tubing shall be used for all above ground piping, as part of the Well's water distribution system, as indicated on the Plans. Copper tubing shall be type K, rigid. Joints shall be solder sweated, threaded, or flanged, as indicated on the drawings.

##### 2.1.2.1 Flanges

Flanges shall be screwed onto threaded pipe and be in accordance with ASME B16.5 class 150. Flanges shall receive isolation flange kits where connecting to dissimilar metals. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall have the manufacturer's trademark affixed in accordance with MSS SP-25.

##### 2.1.2.2 Brazing Material

Brazing material shall conform to AWS A5.8, BcuP-5.

##### 2.1.2.3 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 FS QQ-B-654.

##### 2.1.2.4 Solder Material

Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

##### 2.1.2.5 Solder Flux

Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

##### 2.1.2.6 PTFE Tape

PTFE tape for use with threaded metal or plastic pipe shall be in accordance with ASTM D 3308.

#### 2.1.3 Steel Pipe and Casings

Steel pipe shall be carbon steel material. Pipe shall be of size and dimensions as shown on the plans. When steel pipe is 4-inch and larger in diameter, it shall be in conformance with the latest AWWA Standard that applies.

#### 2.2 FITTINGS AND SPECIALS

### 2.2.1 Polyvinyl Chloride (PVC) Pipe

For pipe less than 4 inch diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings, fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467, and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111. PVC, stainless steel, or bronze fittings and specials shall be supplied where noted on the plans.

## 2.3 JOINTS

### 2.3.1 Plastic Pipe

#### 2.3.1.1 Polyvinyl Chloride Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations and as approved by the Contracting Officer. Isolation flanges or couplings shall be supplied as indicated on the plans.

#### 2.3.2 Transition Couplings

Transition couplings shall be the bolted, mechanical sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline, and provide a pressure seal rated at 150 psi. Body shall be constructed of 1010/1020 carbon steel. Middle rings shall be 1010/1020 carbon steel. Bolts and nuts shall be ANSE A21.11 carbon steel. Gaskets shall be Buna-N rubber. Grippings shall be 4140 carbon steel. Back-up rings shall be 1010/1020 carbon steel.

#### 2.3.3 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings, and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

## 2.4 WATER CONTROL VALVES

### 2.4.1 General Requirements

The Contractor shall furnish and install control valves, complete and operable, as shown and specified herein, all in accordance with the requirements of the Contract Documents.

Spare parts shall be supplied such as repair gaskets, seals, o-rings, and diaphragm for each size and type of control valve.

The Contractor shall submit detailed shop drawings and data.

### 2.4.2 Quality Assurance

#### 2.4.2.1 Valve Testing

Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

#### 2.4.2.2 Bronze Parts

Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or, where not subject to dezincification, to ASTM B 584.

#### 2.4.3 Manufacturer's Responsibility

The valve manufacturer shall verify valve selection based on the specified range of operation as shown in the valve schedule. In case that the valve size or model differ from the specified, recommended data shall be submitted to the Contracting Officer for review. The Contractor shall **include in his submittal, written certification** from the valve manufacturer to the effect that the valve selection has been verified for maximum differential pressure and that the valves when installed will be free from damaging cavitation throughout the operating range.

#### 2.4.4 Deep Well Pump control Valve

##### 2.4.4.1 General

The valves shall be designed to protect pipelines from surges during the starting and stopping of a well pump and to dissipate air and the initial rush of sand from the pump column to atmosphere. The main valve shall be hydraulically operated, diaphragm actuated in globe pattern. The body shall be hydrotested to the rated working pressure. The main valve shall contain a resilient synthetic rubber disc having a rectangular cross section, contained on three and one-half sides by a disc holder and a disc retainer. The seat ring shall be held firmly in place. The seat ring shall not be press fitted into the main body and must be removable in the field without the use of special tools. The main valve shall incorporate two operation chambers sealed from each other by a fabric reinforced diaphragm. The diaphragm shall not be used as a seating surface. Each operation chamber shall be accessible to the pilotry control system. Pressure applied to the upper chamber shall tend to close the valve and pressure applied to the lower chamber shall tend to open the valve. The diaphragm assembly shall be the only moving part. The diaphragm assembly shall be fully guided to ensure positive contact with the seat. Packing glands and/or stuffing boxes are not permitted and there should be no pistons operating the valve. All necessary repairs shall be possible without removing the main valve from the line.

##### 2.4.4.2 Main Valve

The main valve shall be controlled by the use of a four way solenoid pilot valve operating from a line pressure. The supply line to the solenoid shall be protected by a wye strainer. A limit switch must be provided which is adjustable over the entire valve stroke.

The supply pressure for the solenoid shall be piped from the downstream side of the mainline check valve so that the highest operating pressure will be used at all times. Opening and closing speed controls shall be provided.

#### 2.4.4.3 Main Valve Components

The valve shall be similar in all respects to the Ames Model 985G, CLA-VAL Model 61-02, or approved equal.

#### 2.4.5 Check Valve for Well

##### 2.4.5.1 Well Check Valve

The Well Check Valve shall be hydraulically operated, diaphragm actuated in globe pattern. The valve shall close drip tight upon the reversal of pressure at a preset speed. The main valve body shall contain a resilient synthetic rubber disc having a rectangular cross section, contained on three and one-half sides by a disc retainer. The seat ring shall be held firmly in place and not pressed in to the body. The diaphragm assembly shall be fully guided to assure positive contact with the seat. The diaphragm assembly shall be the only moving part. The diaphragm shall consist of a nylon fabric reinforced Buna-N rubber and shall not be used as a seating surface. All necessary repairs shall be possible without removing the valve from the line.

##### 2.4.5.2 Valve Interior Components

The valve interior components shall be manufactured from non-corrosive materials. The valve shall be similar in all respects to the Ames Model 940-04, CLA-VAL Model 81-02, or approved equal.

#### 2.4.6 Installation

##### 2.4.6.1 General

Control valves shall be installed in strict accordance with the valve supplier's printed recommendations, and provisions of the Standard Specifications.

##### 2.4.6.2 Valve Inspection

After installation, all valves shall be inspected by the manufacturer's factory representative. Final setting shall be adjusted.

##### 2.4.7 Operator's Training

The Contractor shall employ the service of a factory-trained technician to train plant operators for a period of one day in the operation, repair, and maintenance of the valves.

##### 2.4.8 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. 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 connecting pipe, and shall be opened by turning counterclockwise. Valves installed above ground shall have a wheel operator, and valves installed below ground shall have a square nut operator. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

- a. Valves smaller than 3 inches shall be all bronze and shall conform

to MSS SP-80, Type 1, Class 150.

- b. Valves 3 inches and larger shall be iron body, resilient wedge and shall conform to AWWA C509. Flanges mating to copper, bronze, or brass shall receive an isolation flange kit.

#### 2.4.9 Vacuum and Air Relief Valves (Combination Air/Vac)

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

#### 2.4.10 Deep Well Air Valve

Valve size shall be 1/2-inch. Body shall be cast iron (ASTM A 126 Gr. B). Baffle, size shall be 1/2-inch Delrin (ASTM D 2133). Float shall be Stainless Steel (ASTM A 240). Seat shall be Buna-N. Water diffuser shall be brass (ASTM B 16). Housing shall be malleable iron (ASTM A 47). Adjustable screw and nut shall be Stainless Steel (ASTM A 276 T304). Spring shall be Stainless Steel (ASTM A 313 T316). Plug shall be teflon (AMS 3651).

#### 2.4.11 Rubber Check Valve

Rubber check valve shall be all rubber and of the flow operated check type with a slip-on end connection. Inlet port areas shall be 100 percent of pipe connection size. The discharge port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow. The check valve shall be designed to slip over the specified pipe outside diameter. The flexible duckbill sleeve shall be one piece of rubber construction with fabric reinforcement. The check valve shall also have a protective EPDM exterior wrapping for protection against sunlight attack. Check valves shall be attached to the pipe outside diameter by means of vendor furnished clamps. Company name, plant location, and valve size and serial number shall be bonded to the exterior of the valve. Valve shall be installed per manufacturer's recommendations.

### 2.5 VALVE BOXES

Valve box covers and frame shall be cast iron. Boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. 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. The PVC valve box shaft pipe shall be set on 3/4 inch gravel on top of the valve. The valve box shaft shall extend below valve nut so that permanent valve operation is available from ground surface.

### 2.6 FLOW MEASUREMENT

#### 2.6.1 Turbine Flow Meter

##### 2.6.1.1 Type

Meters shall be of the in-line horizontal-axis type per AWWA Class II.

#### 2.6.1.2 Capacity

The capacity of the meter shall be 4 to 200 gpm. The maximum loss of water energy across the valve shall be 4.5 psi. The maximum continuous flow shall be 200 gpm. The maximum intermittent capacity shall be 250 gpm.

#### 2.6.1.3 Size

The 2-inch diameter meter shall have a laying length of not greater than 10 inches, and the combined length with strainer shall not exceed 17 inches.

#### 2.6.1.4 Case and Cover

The maincase and cover shall be cast of water works bronze containing not less than 57% copper. The size, model, and arrows indicating direction of flow shall be cast in raised characters on the maincase or cover. The cover shall contain a calibration vane for the purpose of calibrating the turbine measuring element while in-line and under pressure. The calibration vane shall be mounted under the register or shall be covered by a protective cap that is attached in a tamper-resistant device.

#### 2.6.1.5 External Bolts

Casing bolts shall be made of type 316 stainless steel.

#### 2.6.1.6 Connections

Maincases shall be flanged.

#### 2.6.1.7 Registers

Registers shall be permanently rolled-sealed, straight reading, indicating gallons. Registers shall include a center-sweep test hand, a low flow indicator and glass lens. Register shall be serviceable without interruption of the meter's operation.

#### 2.6.1.8 Register Box

Register boxes and covers shall be of bronze composition. No plastic retainer rings will be acceptable. The name of the manufacturer and the meter serial number shall be clearly identifiable and located on the register box cover.

#### 2.6.1.9 Register Box Sealing

The register box shall be affixed to the top cover by means of a plastic tamperproof seal pin that must be destroyed in order to remove the register.

#### 2.6.1.10 Meter Serial Number

The meter serial number shall be imprinted on the meter maincase or cover as well as the register box cover.

#### 2.6.1.11 Measuring Chamber

The turbine measuring chamber shall be a self-contained unit attached to the cover for easy removal. The turbine spindles shall be stainless steel.

#### 2.6.1.12 Intermediate Gear Train

The intermediate gear train shall be directly-coupled to the turbine spindle and magnetically coupled to the register through the meter cover. The gear train shall be capillary sealed. All moving parts of the gear train shall be made of a self-lubricating polymer or stainless steel for operation in water.

#### 2.6.1.13 Performance

Registration accuracy over the normal operating range shall be 98.5 percent to 101.5 percent.

#### 2.6.1.14 Remote Capacity

All meters shall be equipped with generator remotes per AWWA C706, shall meet all AWWA C701 performance standards, and shall include all hardware. Two-wire cable shall not be included in quoted meter prices.

### 2.7 MISCELLANEOUS ITEMS

#### 2.7.1 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.

#### 2.7.2 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.

#### 2.7.3 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

### 2.8 PIPE SUPPORTS

#### 2.8.1 General

The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, and installation of all pipe supports, hangers, guides, and anchors shown, specified or required for a complete and operable piping system, in accordance with the requirements of the contract specifications.

#### 2.8.2 Product Requirements

##### 2.8.2.1 Code Compliance

All piping systems and pipe connections to equipment shall be properly supported, to prevent undue deflection, vibration, and stresses on piping, equipment and structures. All supports and parts thereof shall conform to the requirements of ASME B31.1, except as supplemented or modified by these

specifications. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code, or local administration requirements.

#### 2.8.2.2 Structural Members

Wherever possible, pipes shall be attached to structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor at no additional cost to the Owner. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction.

#### 2.8.2.3 Support Spacing

Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending and shear stresses in the piping, with special consideration given where components, such as flanges and valves, impose concentrated loads. Where calculations are not made or more stringent requirements from pipe manufacturers prevail, suggested maximum spacing of supports are given in the in the tables below. Vertical supports shall be spaced to prevent the pipe from being overstressed from the combination of all loading effect.

#### 2.8.2.4 Riser Supports

Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

#### 2.8.2.5 Freestanding Piping

Freestanding pipe connections to equipment, like chemical feeders, pumps, etc. shall be firmly attached to fabricated steel frames made of angles, channels, or I-beams anchored to the structure. Exterior, free standing overhead piping shall be supported on fabricated pipe stands, consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps, securing the pipes.

#### 2.8.2.6 Noise Reduction

To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be supplied with a two-inch wide strip of rubber fabric or similar, suitable materials, at each pipe support, bracket, clip, or hanger.

#### 2.8.3 Manufactured Supports

Where not specifically shown or detailed, designs, generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.

#### 2.8.4 Coating

##### 2.8.4.1 Galvanizing

Unless otherwise shown or specified, all fabricated pipe supports, other than stainless steel or nonferrous supports, shall be blast-cleaned after

fabrication and hot-dip galvanized in accordance with ASTM A 123.

#### 2.8.4.2 Other Support

All other support shall receive an epoxy coating in accordance with the requirements of Section 09920, "COATING SYSTEMS."

#### 2.8.5 Installation

##### 2.8.5.1 General

All pipe supports, brackets, anchors, guides and insets shall be fabricated and installed in accordance with the manufacturer's printed instructions and ASME B31.1. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

##### 2.8.5.2 Appearance

Pipe supports shall be positioned in such a way as to produce an orderly, neat piping system.

##### 2.8.6 Fabrication

Pipe supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

#### 2.9 BLOW-OFF ASSEMBLY

Blow-off assembly shall consist of a 2-inch diameter schedule 80 PVC pipe riser off the 3-inch well distribution pipeline. The 2-inch PVC pipe riser shall terminate in a concrete meter box with cast iron lid marked "water," and shall have a 2-inch bronze ball valve on the end of the pipe with 2-inch brass plug. The concrete meter box shall be set flush with the concrete well slab foundation in the location indicated on the plans. The meter box shall be open on the bottom and have a 3/4-inch crushed rock base approximately 6-inches deep and 1-foot wider than the box in footprint in all sides.

#### 2.10 DRY PELLETT CHLORINATOR

The well shall be equipped with a dry pellet chlorinator. The chlorinator shall be an approved dry pellet type with a capacity to deliver 3 pellets per minute and a minimum pellet storage capacity of 3-1/2 pounds. The chlorinator shall be connected to the well pump controls. The chlorinator shall operate on 115 volts, 60 Hz, single-phase power. The chlorinator shall be equipped with all necessary controls to provide for automatic operation.

#### 2.11 BLADDER TYPE WATER TANK

A bladder type water tank shall be installed on the discharge piping of the well. The tank shall be constructed for a minimum capacity of 500 gallons and a standard operating pressure of 125 psi. The tank shall be constructed in conformance with ASME Section VIII. The bladder shall be NSF approved and replaceable. The tank shall be factory pre-charged and field adjustable.

### 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.

#### 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 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet 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 or fuel lines.

#### 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.

##### 3.1.3.2 Rigid Copper Tubing

Deflection of threaded and flanged joints is not acceptable.

#### 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 or method. 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 on the construction plans.

#### 3.1.4.1 Plastic Pipe Installation

PVC pipe shall be installed in accordance with AWWA M23. Copper tubing shall be installed in accordance with NAPHCC-01 and NAPHCC-02, unless otherwise shown.

#### 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 ACPA-01.

#### 3.1.4.3 Penetrations

Pipe passing through walls of structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Unless otherwise specified, the annular space between walls and sleeves shall be filled with rich cement mortar, and the annular space between pipe and sleeves shall be filled with mastic, unless otherwise specified.

#### 3.1.4.4 Flanged Pipe

Flanged pipe shall only be installed above ground or where installed below ground shall receive an 8-mil coating of coal tar.

#### 3.1.5 Jointing

##### 3.1.5.1 Polyvinyl Chloride (PVC) Plastic Pipe

- a. Pipe less than 4 inch 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.

### 3.1.5.2 Steel Pipe, Not Galvanized

- a. Mechanical Couplings: Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.
- b. Rubber Gaskets: Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the recommendations of the pipe manufacturer.

### 3.1.5.3 Isolation Joints

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph: JOINTS.

### 3.1.5.4 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 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet 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.

### 3.1.7 Field Coating and Lining of Pipe

#### 3.1.7.1 Steel Pipe 3 Inches and Larger, Not Galvanized

Coal-tar enamel coating, lining and wrapping: Field jointing shall conform to AWWA C203. The applied materials shall be tested by means of a spark-type electrical inspection device in accordance with the requirements of AWWA C203. Any flaws or holidays found in the coating and/or lining of pipe and joints shall be repaired by patching or other approved means. The repaired areas shall be at least equal in thickness to the minimum coating and/or lining required for the pipe.

### 3.1.8 Setting of Valves and Valve Boxes

#### 3.1.8.1 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 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

### 3.1.8.2 Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

### 3.1.9 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, 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 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 2,000 psi 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, as directed or per applicable pipe manufacture's recommendations. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

#### 3.1.9.2 Restrained Joints

Restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with standard practices.

#### 3.1.10 Installation of Dry Pellet Chlorinator

The dry pellet chlorinator shall be installed on the well per the manufacturer's instructions.

#### 3.1.11 Installation of Bladder Type Water Tank

The bladder type water tank shall be installed and anchored to the concrete slab in accordance with the manufacturer's recommendations. The Contractor shall field-adjust the pressure charge in the tank for proper operation of the water system. Prior to installation of the well slab foundation the contractor shall propose a method for anchoring the water tank to the concrete well slab foundation.

### 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 100 psi or 150 percent of the working pressure, whichever is greater. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, 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.

### 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 the specified test pressure. 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 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 1/2 \text{ power})$$

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.

## 3.3 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. Apply chlorine by the continuous feed method.

## 3.4 CLEANUP

Upon completion of the installation of water equipment, pipe and appurtenances, all debris and surplus materials resulting from the work

shall be removed.

-- End of Section --

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## SECTION 03305

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## SECTION 03305

## CAST-IN-PLACE STRUCTURAL CONCRETE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	(1977; R 1989) Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 318/318R	(1995) Building Code Requirements for Structural Concrete and Commentary
ACI 503.2	(1992; R 1997) Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy System

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A137.1	(1988) Ceramic Tile
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31	(1998) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1997) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	(1992) Organic Impurities in Fine Aggregates for Concrete
ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beam of Concrete

ASTM C 94	(1998c) Ready-Mixed Concrete
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
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	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1978; R 1990) Clay Lumps and Friable Particles in Aggregates
ASTM C 143	(1997) Slump of Hydraulic Cement Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete
ASTM C 172	(1997) Sampling Freshly Mixed Concrete
ASTM C 192	(1995) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997e1) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(1995) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1998) Chemical Admixtures for Concrete
ASTM C 535	(1989) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 566	(1989) Total Moisture Content of Aggregate by Drying
ASTM C 597	(1983; R 1991) Pulse Velocity Through Concrete
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 803	(1990) Penetration Resistance of Hardened Concrete

ASTM C 805	(1994) Rebound Number of Hardened Concrete
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 928	(1992a) Packaged Dry, Rigid-Hardening Cementitious Materials for Concrete Repairs
ASTM C 937	(1980; R 1991) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1059	(1991) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064	(1986; R 1993) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1991a) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 4791	(1995) Flat or Elongated Particles in Coarse Aggregate

## CORPS OF ENGINEERS (COE)

COE EM 1110-2-2000	Engineering and Design - Standard Practice for Concrete
COE ER 1110-1-2002	(1998) Cement, Slag, and Pozzolan Acceptance Testing
COE CRD-C 55	(1995) Within-Batch Uniformity of Freshly Mixed Concrete
COE CRD-C 94	(1995) Specifications for Surface Retarders
COE CRD-C 100	(1975) Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 143	(1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregate
COE CRD-C 318	(1979) Cloth, Burlap, Jute (or Kenaf)

COE CRD-C 400 (1963) Requirements for Water for Use in Mixing or Curing Concrete

COE CRD-C 521 (1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44 (1994) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100 (1990) Concrete Plant Standards

1.2 GOVERNMENT TESTING AND STUDIES

1.2.1 Preconstruction Testing and Mixture-Proportioning Studies

1.2.1.1 Aggregates

The aggregate sources listed in paragraph: MATERIAL SPECIFICATION, have been tested, and at the time testing was performed, these sources were capable of producing materials of the quality and quantity required for this project provided suitable processing is performed. Samples from any source selected consisting of not less than 100 pounds of each size of coarse aggregate and 250 pounds of fine aggregate, taken under the supervision of the Contracting Officer in accordance with COE CRD-C 100, shall be delivered to the US Army Corps of Engineers, Engineering Research and Development Center (ERDC), 3909 Halls Ferry Road, Vicksburg MS, 39180-6199, ATTN:Toy Poole, CEERD-GM-C; within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. 60 days will be required to complete evaluation of the aggregates. Testing will be performed by the Government in accordance with the applicable COE CRD-C or ASTM test methods. Tests to which aggregate may be subjected are listed in paragraph: MATERIAL SPECIFICATION. The material from the proposed source shall meet the quality requirements of this paragraph to be used for the project. The Government test data and other information on aggregate quality of those sources listed in paragraph: MATERIAL SPECIFICATION, and are available for review in the District Office. Quality assurance testing of aggregates by the Government does not relieve the Contractor of quality control requirements.

1.2.1.2 Cementitious Materials, Admixtures, and Curing Materials

Notify the Contracting Officer of the source, brand name, type, and quantity of all materials (other than aggregates) to be used in the manufacture and curing of the concrete at least 60 days in advance of submitting samples for mixture proportioning studies. The Contractor shall assist the Contracting Officer in obtaining samples of each material. Sampling and testing as determined appropriate will be performed by and at the expense of the Government. If cement or pozzolan are to be obtained from more than one source, the notification shall state the estimated amount of cement or pozzolan to be obtained from each source and the proposed schedule of shipments. When pozzolan other than fly ash is used, it shall be from one source.

### 1.2.1.3 Materials for Mixture-Proportioning Studies

At least 135 days in advance of the time when placing of concrete is expected to begin, samples of representative materials proposed for this project and meeting all the requirements of this specification shall be delivered to US Army Corps of Engineers, Engineering Research and Development Center (ERDC), 3909 Halls Ferry Road, Vicksburg MS, 39180-6199, ATTN:Toy Poole, CEERD-GM-C, by the Contractor at his expense. Samples of aggregates shall be taken under the supervision of the Contracting Officer in accordance with COE CRD-C 100, accompanied by test reports indicating conformance with grading and quality requirements hereinafter specified. Samples of materials other than aggregates shall be representative of those proposed for the project and shall be submitted accompanied by manufacturer's test reports indicating compliance with applicable specified requirements. Quantities of materials required shall be as follows:

MATERIAL	QUANTITY
1-1/2 inch nominal maximum-size coarse aggregate	7,000 pounds
3/4 inch nominal maximum-size coarse aggregate	8,000 pounds
Fine aggregate	11,000 pounds
Cement	4,000 pounds
Pozzolans	1,500 pounds
Ground Granulated Blast Furnace Slag	4,000 pounds
Chemical Admixtures (each)	5 gallons

Mixture-proportioning studies will be made by the Government at its expense.

### 1.2.2 Construction Testing by the Government

#### 1.2.2.1 General

The Government will sample and test cementitious materials, admixtures, aggregates, and concrete during construction as considered appropriate to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with COE CRD-C 100. Slump will be determined in accordance with ASTM C 143, except the point of sampling will be as directed. Compression test specimens will be made and laboratory cured in accordance with ASTM C 31 and will be tested in accordance with ASTM C 39.

#### 1.2.2.2 Testing Aggregates

Testing performed by the Government will not relieve the Contractor of his responsibility for testing as appropriate for quality control. During construction, aggregates will be sampled for acceptance testing as delivered to the mixer to determine compliance with specification provisions. The Contractor shall provide necessary facilities and labor for the ready procurement of representative samples under Contracting Officer supervision. The Government will test such samples at its expense using appropriate COE CRD-C and ASTM methods.

#### 1.2.2.3 Cementitious Materials

Cementitious materials shall be sampled at the mill, shipping point, or site of the work by the Contracting Officer. If tests prove that a material which has been delivered is unsatisfactory, it shall be promptly removed from the site of the work. Cementitious materials that have not been used within 6 months after being tested will be retested by the Government at the expense of the Contractor when directed.

#### 1.2.2.4 Cement

Cement shall be tested for conformance with ASTM C 150 and the requirements specified herein. The cement will also be evaluated under the guidelines used to establish a qualified cement source as outlined in COE ER 1110-1-2002; Appendix A, Cement Quality Management System. The cement producer will be required to submit samples for physical and chemical testing, as well as historic quality control data. Cement will be sampled and tested by or under the supervision of the Contracting Officer and at the Government's expense. No cement shall be used until notice has been given by the Contracting Officer that test results for chemical and physical requirements as well as all evaluation requirements are satisfactory. In the event of failure, the cement may be resampled and tested at the request of the Contractor and at the Contractor's expense. Cement will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. A copy of the mill tests from the cement manufacturer shall be furnished to the Contracting Officer for each lot delivered to the site of the work. The cost of testing cement excess to project requirements or of retesting as a result of failure of tests or change of sources will also be at the Contractor's expense and will be deducted from payments due the Contractor at a rate of \$3,200.00 per test. Material not meeting specifications shall be promptly removed from the site of work.

#### 1.2.2.5 Pozzolan

The pozzolan shall be tested for conformance with ASTM C 618 and the requirements specified herein. The pozzolan will also be evaluated under the guidelines used to establish a qualified pozzolan source as outlined in COE ER 1110-1-2002; Appendix B, Pozzolan Quality Management System. The pozzolan producer will be required to submit samples for physical and chemical testing, as well as historic quality control data. Pozzolan will be sampled and tested by or under the supervision of the Contracting Officer and at the Government's expense. No pozzolan shall be used until notice has been given by the Contracting Officer that test results for chemical and physical requirements as well as all evaluation requirements are satisfactory. In the event of failure, the pozzolan may be resampled and tested at the request of the Contractor and at the Contractor's expense. Pozzolan will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. A copy of the mill tests from the pozzolan manufacturer shall be furnished to the Contracting Officer for each lot delivered to the site of the work. The cost of testing pozzolan excess to project requirements or of retesting as a result of failure of tests or change of sources will also be at the Contractor's expense and will be deducted from payments due the Contractor at a rate of \$3,200.00 per test. Material not meeting specifications shall be promptly

removed from the site of work.

1.2.2.6 (Deleted)

1.2.2.7 (Deleted)

1.2.2.8 Ground Granulated Blast-Furnace Slag

Ground Granulated Blast Furnace Slag (GGBFS) shall be tested for conformance with ASTM C 989 and the requirements specified herein. The GGBFS will also be evaluated under the guidelines used to establish a qualified GGBFS source as outlined in COE ER 1110-1-2002; Appendix A, Cement Quality Management System. The GGBFS producer will be required to submit samples for physical and chemical testing, as well as historic quality control data. GGBFS will be sampled and tested by or under the supervision of the Contracting Officer and at the Government's expense. No GGBFS shall be used until notice has been given by the Contracting Officer that test results for chemical and physical requirements as well as all evaluation requirements are satisfactory. In the event of failure, the GGBFS may be resampled and tested at the request of the Contractor and at the Contractor's expense. GGBFS will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. A copy of the mill tests from the GGBFS manufacturer shall be furnished to the Contracting Officer for each lot delivered to the site of the work. The cost of testing GGBFS excess to project requirements or of retesting as a result of failure of tests or change of sources will also be at the Contractor's expense and will be deducted from payments due the Contractor at a rate of \$3,200.00 per test. Material not meeting specifications shall be promptly removed from the site of work.

1.2.2.9 Chemical Admixtures

The Contractor shall provide satisfactory facilities for ready procurement of adequate test samples. All sampling and testing of a chemical admixture will be by and at the expense of the Government. Tests will be conducted using samples of materials proposed for the project.

1.2.2.10 Concrete Strength

Compressive strength test specimens will be made by the Government and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39.

The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength  $f'c$  and no individual test result falls below the specified strength  $f'c$  by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including nondestructive testing, 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.

- a. Investigation of Low-Strength Test Results - When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and

curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803, or ASTM C 805 may be permitted by the Contracting Officer to estimate the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.

- b. Testing of Cores - When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the performance of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement.
- c. Load Tests - If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies will be performed and approved by the Contracting Officer at the expense of the Contractor, except that if all concrete is in compliance with the plans and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

### 1.3 DESIGN REQUIREMENTS

The following requirements are for mixture proportions prepared by the contractor.

#### 1.3.1 Concrete Strength

Minimum specified compressive strength  $f'_c$  shall be as follows:

COMPRESSIVE STRENGTH (PSI)	STRUCTURE OR PORTION OF STRUCTURE
4,000 @ 28 days*	Intake structure, transition structure, outlet conduit, stilling basin, and parabolic drop structure
4,000 @ 28 days	Bridge elements, precast elements, generator and gaging station building foundation, and structural elements not described below
3,250 @ 28 days	Bridge footings and bridge retaining walls
3,000 @ 28 days	Runout channel, outlet channel, and concrete not described elsewhere

COMPRESSIVE STRENGTH (PSI)	STRUCTURE OR PORTION OF STRUCTURE
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2,500 @ 28 days	Temporary concrete
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1,000 @ 28 days	Lean mix concrete backfill
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\* Concrete used in parts of these structures will be proportioned by the Contracting Officer.

#### 1.3.2 Maximum Water-Cement (W/C) Ratio

Maximum W/C shall be as follows:

WATER-CEMENT RATIO, BY MASS	STRUCTURE OR PORTION OF STRUCTURE
0.45	Intake structure, transition structure, outlet conduit, stilling basin, and parabolic drop structure
0.50	Permanent concrete construction exposed to soils or water not described elsewhere
0.50	Bridge deck slabs, prestressed and precast members, and generator and gaging station building foundation
0.55	Other portions of bridge structures
0.65	Temporary concrete, lean mix concrete and concrete not described elsewhere

These W/C's may cause higher strengths than that required by paragraph: CONCRETE STRENGTH.

#### 1.4 CONSTRUCTION TOLERANCES

##### 1.4.1 General

Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal. Tolerances are not cumulative. The most restrictive tolerance controls. Tolerances shall not extend the structure beyond legal boundaries. Except as specified otherwise, plus tolerance increases the amount or dimension to which it applies, or raises a level alignment and minus tolerance decreases the amount or dimension to which it applied, or lowers a level alignment. A tolerance without sign means plus or minus. Where only one signed tolerance is specified, there is no limit in the other direction. The unformed finished surfaces subject to high-velocity flow (40 fps) shall be finished to meet the tolerances for A-HV surfaces specified in Table, "TOLERANCES FOR FINISHED FORMED CONCRETE SURFACES".

The definitions of the terms used in the following tabulations are used as defined and used in ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing.

TABLE I. CONSTRUCTION TOLERANCES FOR INTAKE STRUCTURE

(a)	Variation of the constructed linear outline from the established position in the plan	20 feet..... 1/2 inch Maximum..... 1 inch
(b)	Variation in dimensions to individual structure features from established positions	In 80 feet or more.... 1 inch In buried construction And bulkhead faces.... 2 inches
(c)	Variation from the plumb, from the specified batter, or from the curved surfaces of all structures, including the lines and surfaces of columns, walls, piers, buttresses, arch sections, vertical joint grooves, and visible arises	In any 10 feet. ....2 inch In any 20 feet. ....3/4 inch Maximum..... .. 1-1/4 inches In buried ..... .. Twice construction the above amounts
(d)	Variation from the level or from the grades indicated ion the drawings in slabs, beams, soffits, horizontal joint grooves, and visible arises	In any 10 feet..... 5/16 inch In any 30 feet or more. 1/2 inch In buried construction. Twice the above amounts
(e)	Variation in cross-sectional dimensions of columns, beams, wet well walls, and similar members	Minus..... 1/4 inch Plus..... 1/2 inch
(f)	Variation in the thickness of slabs, walls, arch sections, and similar members	Minus..... 1/4 inch Plus..... 1/2 inch
(g)	Variation in the sizes and locations of sleeves, floor openings, and wall openings	..... 1/4 inch
(h)	For watertight joints such as guides and sill areas, variations from the plumb and level	Not greater than 1/8 inch In 10 feet

TABLE II. TOLERANCES FOR OTHER THAN INTAKE STRUCTURE

(a)	Variation of the constructed linear outline from the established position in the plan	20 feet..... 1/2 inch Maximum..... . 1 inch
(b)	Variation in dimensions to individual structure features from established positions	Maximum..... 1/2 inch In flow areas..... 1/4 inch
(c)	Variation from the plumb, from the specified batter, or from the curved surfaces	In any 10 feet..... 1/2 inch Maximum..... 1 inch
(d)	Variation from the level or from the grades indicated on the	In any 10 feet.....5/16 inch In any 30 feet or more. 1/2 inch

TABLE II. TOLERANCES FOR OTHER THAN INTAKE STRUCTURE

	drawings in slabs, beams, water conveying conduits, soffits, horizontal joint grooves, and visible arises	
(e)	Variation in cross-sectional dimensions of columns, beams, walls, and similar members	Minus..... 1/4 inch Plus..... 1/2 inch
(f)	Variation in the sizes and locations of sleeves and openings in floors, roofs, and walls	..... 1/4 inch

TABLE III. TOLERANCES FOR BRIDGES

(a)	Departure from established alignment	..... 1 inch
(b)	Departure from established grades	..... 1 inch
(c)	Variation in cross-sectional dimensions of columns, piers, slabs, walls, beams, and similar parts	Minus..... 1/4 inch Plus..... 1/2 inch
(d)	Variation in thickness of bridge slabs	Minus..... 1/8 inch Plus..... 1/4 inch
(e)	Footings	
	i. Variation of dimensions in plan	Minus..... 1/2 inch Plus..... 2 inches When formed or plus 3 inches when placed against unformed excavation
	ii. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than.....2 inches
	iii. Reduction in thickness	Minus..... .5 percent

1.4.2 Surface Requirements

1.4.2.1 General

The surface requirements for the classes of finish required by paragraph shall be as hereinafter specified. Allowable irregularities are designated "abrupt" or "gradual" for purposes of providing for surface variations. Offsets resulting from displaced, misplaced, or mismatched forms shall be considered "abrupt" irregularities. Irregularities resulting from warping, unplaneness, or similar uniform variations from planeness, or true curvature, shall be considered "gradual" irregularities. "Gradual" irregularities will be checked for compliance with the prescribed limits

with a 5-foot template, consisting of a straight edge for plane surfaces and a shaped template for curved or warped surfaces. In measuring irregularities, the straightedge or template may be placed anywhere on the surface in any direction, with the testing edge held parallel to the intended surface.

Class of Finish	Maximum Irregularities	
	Abrupt, Inches	Gradual, Inches
HV	*	1/8
PV	1/8	1/4
Other	1/4	1/2
Backfill	1	1

\* Variation for Class HV finish shall not exceed zero positive and 1/8-inch negative in the direction of flow of the water.

1.4.2.2 Grinding

Grinding of concrete to meet HV surface requirements is acceptable up to a maximum of 10 exposed aggregate particles with any dimension exceeding 1/4-inch in any 1-square-foot area. The required grinding bevel is as follows:

Station	Bevel (Minimum)
9+10 to 21+02.50	1 to 20

Grinding of surfaces is acceptable up to a maximum of 1/2 inch of removed concrete.

1.4.2.3 Prevention of Repeated Failure to Meet Tolerances

When a concrete placement results in concrete (prior to grinding or patching) that does not meet specified tolerances or surface requirements, an outline of all preventative actions such as modifications to forming, placing, or finishing, to be implemented by the Contractor to avoid repeated failures shall be submitted upon request. The Government reserves the right to delay concrete placements until such approved preventive actions have been implemented.

1.4.3 Appearance

Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method that does not harm the concrete and that is approved by the Contracting Officer.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

- SD-02 Shop Drawings
- Plant Layout, G.

Drawings showing the layout of the plant proposed for use at least 30 days prior to beginning of the plant installation. The drawings shall show the location of the principal components of the construction plant; offices; shop and storage facilities; and storage areas and yards which the Contractor proposes to construct within the project limits. Drawings shall also be furnished showing the general features of the aggregate processing plant; aggregate transporting, storage and reclaiming facilities; coarse aggregate rescreening plant; concrete batching and mixing plant; concrete conveying and placing plant; and worker's hoists. The drawings shall appropriately show the capacity of each major feature of the plant; rated capacity of the aggregate transporting storage and reclaiming facilities; volume of aggregate stored; capacity of cement storage; rated capacity of the concrete batching and mixing plant; rated capacity of the worker's hoists. The size of the mixers and bins and the structural components of the plant shall also be shown. The layout of other construction facilities shall be provided in sufficient detail to demonstrate adequacy of the facility. The plant layout shall show the proposed location of the laboratory and adjacent parking lot with access roads. Drawings showing any changes in plant made during design and erection or after the plant is in operation shall also be submitted. Final drawings will be submitted in a computerized graphics form satisfactory to the Contracting Officer.

#### Lift Drawings, G.

A lift drawing and bill of materials shall be furnished for each lift of concrete. (Only one lift shall be shown on a drawing). These drawings shall be to scale and shall show all embedded items in sufficient detail for the proper installation and prosecution of the work. All embedded electrical and/or mechanical items shall be identified. The drawings shall not be less than 22 by 34 inches in size and the scale used shall be sufficiently large to clearly show all details of the structure covered by these drawings. A note shall be included on each lift drawing indicating all contract drawings from which the lift drawing was prepared. The contractor shall submit 6 copies of each drawing for review at least 60 days prior to scheduling the lift for placement. Final drawings will be submitted in a computerized graphics form satisfactory to the Contracting Officer.

#### SD-03 Product Data

##### Batch Plant, G.

Details and data on the concrete plant shall be submitted within 60 days prior to assembly for review by the Contracting Officer for review for conformance with the requirements of paragraph: EQUIPMENT.

##### Mixers

The make, type, capacity, and number of the concrete mixers proposed for use shall be submitted 60 days prior to installation for review by the Contracting Officer for conformance with the requirements of paragraph: EQUIPMENT.

##### Contractor Supplied Mixture Proportions, G.

Concrete mixture proportions for concrete mixtures as indicated hereinafter to be prepared by the Contractor. The concrete mixture quantities of all ingredients per cubic yard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate the mass of cement, pozzolan or slag when used and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

#### Construction Methods; G.

The method, personnel, and equipment proposed for concrete placement of all concrete monoliths 60 days before placement begins. A separate submittal is required for each area, (such as foundation, tower and gates, downstream conduits, and outlet channel. A complete chronological procedure including forms, bulkheads, reinforcement, waterstops, concrete placement, vibration, finishing, joint cleanup, curing, protection, repair of defects, and Contractor quality control shall be included. The plan for placement of concrete in massive elements shall include information as shown in COE EM 1110-2-2000, Chapter 2, Figure 2. The Government reserves the right to delay concrete placements that do not have or are not in accordance with a construction methods as approved by the Contractor Officer.

#### SD-05 Design Data

Testing Technicians; G.  
Concrete Construction Inspector; G.

The Contractor shall submit statements that the concrete testing technicians and the concrete inspectors meet the requirements of paragraph: TESTS AND INSPECTION.

#### Equipment for Conveying

The methods and description of the equipment proposed for transporting, handling, and depositing the concrete shall be submitted for review 60 days before concrete placement begins. The data submitted shall include site drawings or sketches with locations of equipment and placement site.

#### Construction Joint Treatment; G.

The method and equipment proposed for joint cleanup and waste disposal shall be submitted for approval for conformance with paragraph: CONSTRUCTION JOINT TREATMENT.

#### Curing and Protection; G.

The curing media and methods to be used shall be submitted for approval for conformance with paragraph: CURING AND PROTECTION.

#### Cold Weather Placing; G.

When concrete is to be placed under cold-weather conditions, a description of the materials and methods proposed for protection of the concrete meeting the requirements of paragraph: COLD WEATHER PROTECTION shall be submitted for approval.

#### Hot-Weather Placing; G.

When concrete is to be placed under hot-weather conditions, a description of the materials and methods proposed for protection of the concrete meeting the requirements of paragraph: HOT-WEATHER PLACING and FINISHING shall be furnished 60 days in advance of anticipated need date for approval.

#### Special Temperature-Controlled Concrete

When special temperature controls as specified by paragraph: SPECIAL TEMPERATURE-CONTROLLED CONCRETE are required, all methods and equipment shall be submitted for review and comment 60 days in advance of anticipated date required for use.

#### SD-07 Certificates

##### Sheet Curing

If sheet curing is used, a manufacturer's certificate shall be furnished certifying that the materials complies with the requirements of ASTM C 171.

##### Nonshrink Grout; G.

Descriptive literature of the grout proposed for use containing certified laboratory test results showing that it meets ASTM C 1107 shall be submitted 60 days prior to its use together with a certificate from the manufacturer stating that the grout is suitable for the application or exposure for which it is being considered. In addition, a detailed plan shall be submitted for review, showing equipment and procedures for use in mixing and placing the grout.

##### Bonding Agents

Descriptive literature and certification shall be submitted in advance of their use showing that the following materials meet the specified standards:

Latex Bonding Agent  
Epoxy Resin

##### Expansive Admixture

Manufacturer's descriptive literature for fluidifier to be used as expansive admixture in block-out concrete with certificate stating that the material meets the requirements of ASTM C 937 shall be submitted 60 days prior to its use.

##### Color Admixture; G

When color-conditioned concrete is specified, color admixture shall be introduced in the concrete. Color sample shall be available with the Contracting Officer, and the color additive shall be submitted for review and approval 60 days prior its use.

Floor and Wall Tiles; G

Sample of tiles and grout shall be submitted to the Contracting Officer for approval and color selection.

Admixtures; G

Descriptive literature and manufacturer's certificate that the admixture conforms to the requirements of ASTM C 260 or ASTM C 494 as specified hereinafter.

## 1.6 MATERIAL DELIVERY, STORAGE, AND HANDLING

### 1.6.1 Cementitious Materials

#### 1.6.1.1 Transportation

When bulk cement, pozzolan, or ground granulated blast-furnace slag is not unloaded from primary carriers directly into weather-tight hoppers at the batching plant, transportation from the railhead, mill, or intermediate storage to the batching plant shall be accomplished in adequately designed weather-tight trucks, conveyors, or other means that will protect the material from exposure to moisture.

#### 1.6.1.2 Storage

Cementitious materials shall be furnished in bulk except that cement used for finishing and patching may be packaged. Immediately upon receipt at the site of the work, all cementitious materials, shall be stored in separate dry, weather-tight, and properly ventilated structures. All storage facilities shall permit easy access for inspection and identification. Sufficient materials shall be in storage to complete any lift of concrete started. In order that cement may not become unduly aged after delivery, the Contractor shall use any cement that has been stored at the site for 60 days or more before using cement of lesser age.

#### 1.6.1.2 Separation of Materials

Separate facilities shall be provided for unloading, transporting, and handling each cementitious material. Separate appropriate storage facilities shall be provided for each type of cement and each source of pozzolan, or slag. The contents of each storage facility shall be plainly marked with a large permanent sign posted near the loading port.

### 1.6.2 Aggregate Storage

Fine aggregate and each size of coarse aggregate shall be stored in separate size groups adjacent to the batch plant and in such a manner as to prevent the intermingling of size groups or the inclusion of foreign materials in the concrete. Sufficient fine and coarse aggregate shall be maintained at the site at all times to permit continuous placement and completion of any lift of concrete started.

## PART 2 PRODUCTS

## 2.1 MATERIALS

## 2.1.1 Cementitious Materials

## 2.1.1.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II or V, low-alkali. The Contractor shall submit written certification for the heat of hydration limit as stated herein above for each order of cement delivered to the job at least one day prior to the cement delivered on the job site.

Cement in mixtures for the special temperature control concrete, placed in accordance with the Low Heat Mixtures as described in paragraph Special Temperature-Controlled Concrete shall have the heat of hydration limited to 70 calories per gram at 7 days.

Cement in mixtures for the special temperature control concrete, placed in accordance with the High Heat Mixtures as described in paragraph Special Temperature-Controlled Concrete need not have the heat of hydration limited to 70 calories per gram at 7 days.

## 2.1.1.2 Pozzolan

Pozzolan shall conform to ASTM C 618, Class F, with the loss on ignition limited to 6 percent.

## 2.1.1.3 Ground Granulated Blast-Furnace Slag

Ground granulated blast-furnace slag shall conform to ASTM C 989, **Grade 100 or 120**.

## 2.1.1.4 Portland Cement for use with the Ground Granulated Blast-Furnace Slag Concrete Mixtures

For those mixtures prepared by the Government, the contractor may be allowed to use an ASTM C 150 Type II, low alkali cement, without the heat of hydration limited to 70 calories per gram at 7 days.

## 2.1.1.5 Temperature of Cementitious Materials

The temperature of the cementitious materials as delivered to the site shall not exceed 150 degrees F.

## 2.1.2 Admixtures

All chemical admixtures furnished as liquids shall be in a solution of suitable viscosity for field use as determined by the Contracting Officer.

## 2.1.2.1 Accelerating Admixture

Calcium chloride shall not be used. Accelerators shall meet the requirements of ASTM C 494, Type C.

## 2.1.2.2 Retarding Admixture

A retarding admixture shall meet the requirements of ASTM C 494, Type B, or

D, except that the 6-month and 1-year compressive strength tests are waived. The admixture may be added to the concrete mixture only when approved.

#### 2.1.2.3 Water-Reducing Admixture

Water-reducing admixtures shall conform to ASTM C 494, Type A.

#### 2.1.2.4 Expansive Admixture

Expansive admixture used in block-out concrete shall conform to ASTM C 937.

#### 2.1.2.5 Color Admixture

Color admixture for color-conditioned concrete shall match the color sample available from the Contracting Officer.

#### 2.1.2.6 Air-Entraining Admixture

Air Entraining admixture shall conform to ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

#### 2.1.3 Curing Materials

##### 2.1.3.1 Sheet Materials

Sheet curing materials shall conform to ASTM C 171, type optional, except polyethylene sheet shall not be used.

##### 2.1.3.2 Membrane-Forming Curing Compound

Membrane-forming curing compound shall conform to ASTM C 309, Type 2, except a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B, requirements may be used for surfaces that are to be painted or are to receive subsequent coatings, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, coating, or flooring specified.

##### 2.1.3.3 Burlap

Burlap for curing purposes shall conform to COE CRD-C 318.

#### 2.1.4 Water

Water for washing aggregates and for mixing and curing concrete shall be free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances and shall comply with COE CRD-C 400.

#### 2.1.5 Aggregates

##### 2.1.5.1 Aggregate Composition

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of natural and manufactured sands. Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, or a combination thereof.

##### 2.1.5.2 Quality

Aggregates delivered to the mixer shall be obtained from the specified sources and shall conform to the requirements of ASTM C 33.

2.1.5.3 Grading

- a. Fine Aggregate - The grading of the fine aggregate as delivered to the mixers shall be such that the individual percent retained on any sieve shall not vary more than 3 percent from the percent retained on that sieve in a fixed grading selected by the Contractor with the approval of the Contracting Officer. The fixed grading may be selected at the start of concrete placement and based upon 30 days fine aggregate production or selected after the first 30 days of concrete placement. The minimum individual percent retained on the No. 8 sieve shall be 5 percent and on all smaller sieves shall be 10 percent. In addition to the grading limits, the fine aggregate, as delivered to the mixer, shall have a fineness modulus of not less than 2.25 nor more than 2.85. The grading of the fine aggregate shall also be controlled so that the fineness moduli groups (average of the current test and the previous two tests) of the fine aggregate as delivered to the mixer shall not vary more than 0.10 from the target fineness modulus of the fixed grading selected by the Contractor and approved by the Contracting Officer. The range of each group shall not exceed 0.20. The fineness modulus shall be determined in accordance with COE CRD-C 104. At the option of the Contractor, fine aggregate may be separated into two or more sizes or classifications, but the uniformity of grading of the separate sizes shall be controlled so that they may be combined throughout the job in fixed proportions established during the first 30 days of concrete placement. The selected fixed grading shall be within the following limits, except any individual test result may be outside these limits if within the allowable 3 percent variation from the selected grading.

U.S. STANDARD SIEVE DESIGNATION	PERMISSIBLE LIMITS PERCENT BY WEIGHT, PASSING
3/8-in.	100
No. 4	95 - 100
No. 8	80 - 95
No. 16	60 - 80
No. 30	35 - 60
No. 50	15 - 30
No. 100	5 - 10
No. 200	0 - 5

- b. Coarse Aggregate - The coarse aggregate shall be rescreened just prior to delivery to the concrete batch plant bins. The grading of the coarse aggregate within the separate size groups shall conform to the following requirements as delivered to the mixer.

U.S. STANDARD SIEVE DESIGNATION	PERCENT BY WEIGHT PASSING INDIVIDUAL SIEVES	
	No.4 to 1 inch	3/4 inch to 1-1/2 inch
2 inch	-	100
1-1/2 inch	100	90 - 100

**PERCENT BY WEIGHT PASSING  
INDIVIDUAL SIEVES**

U.S. STANDARD SIEVE DESIGNATION	No.4 to 1 inch	3/4 inch to 1-1/2 inch
1 inch	90 - 100	5 - 40
3/4 inch	55 - 85	0 - 15
3/8 inch	8 - 20	0 - 5
No. 4	0 - 5	-
No. 8	0 - 5	-
No. 200	0 - 2	0 - 2

#### 2.1.5.4 Particle Shape

The quantity of flat and elongated particles in the separate size groups of coarse aggregate, as determined by ASTM D 4791, using a value of 3 for width-thickness ratio and length-width ratio shall not exceed 25 percent in any size group.

#### 2.1.5.5 Moisture Content

The fine aggregate shall not be placed in bins at the batch plant until it is in a stable state of moisture content. A stable moisture content shall be reached when the variation in the percent of total moisture tested in accordance with ASTM C 566 and when sampled at the same location will not be more than 0.5 percent during 1 hour of the 2 hours prior to placing the material in the batch plant bins and the variation in moisture content when sampled at the same location shall not be more than 2.0 percent during the last 8 hour period that the aggregate remains in the stockpile. The coarse aggregate shall be delivered to the mixers with the least amount of free moisture and the least variation in free moisture practicable under the job conditions. Under no conditions shall the coarse aggregate be delivered to the mixer "dripping wet".

#### 2.1.5.6 Commercial Concrete Aggregate Sources

Concrete aggregates may be furnished from any source capable of meeting the quality requirements stated in paragraph: AGGREGATES. The following sources were evaluated during the design phase of the project in 1995 and were found at that time capable of meeting the quality requirements when suitably processed. No guarantee is given or implied that any of the following listed sources are currently capable of producing aggregates that meet the required quality stated in paragraph: AGGREGATES. Test results and conclusions shall be considered valid only for the sample tested and shall not be taken as an indication of the quality of all material from a source nor for the amount of processing required.

a. List of Sources:

Robertsons Redimix, Gypsum Canyon  
Sunwest Materials, Lytle Creek  
Inland Rock Co., Day Creek

b. Selection of Source - After the award of the contract, the Contractor shall designate in writing only one source or combination of sources from which he proposes to furnish aggregates. Regardless of the source selected, samples for quality-assurance testing shall be provided as required by

paragraph: PRECONSTRUCTION TESTING AND MIXTURE-PROPORTIONING STUDIES. If a source for coarse or fine aggregate so designated by the Contractor does not meet the quality requirements stated in the paragraph: AGGREGATE, the Contractor may not submit for approval other sources but shall furnish the coarse or fine aggregate, as the case may be, from one or a combination of the sources listed at no additional cost to the Government.

#### 2.1.6 Nonshrink Grout

Nonshrink grout for use in setting base plates and machinery shall conform to ASTM C 1107, and shall be a commercial formulation suitable for the application proposed. The Grade of grout shall be as indicated by the manufacturer, for the particular application selected.

#### 2.1.7 Packaged Dry Repair Materials

Packaged dry rapid-hardening cementitious materials for concrete repairs shall be a commercial formulation conforming to ASTM C 928 requiring only the addition of water.

#### 2.1.8 Bonding Agents

Bonding agents shall meet the following requirements.

##### 2.1.8.1 Latex Bonding Agent

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059, Type II.

##### 2.1.8.2 Epoxy Resin

Epoxy resins for use in grouting dowels shall conform to ASTM C 881, Type IV.

#### 2.1.9 Surface Retarder

Surface retarder shall conform to COE CRD-C 94.

#### 2.1.10 Floor and Wall Tiles

Tiles for floor and walls in the toilet room shall be 1" x 1" x 3/8" and shall be standard grade glazed tiles conforming to ANSI A137.1. Specially shaped tiles shall be provided as required at corners, edges, etc.

### 2.2 MIXTURE PROPORTIONING

#### 2.2.1 Composition

Concrete shall be composed of cementitious materials, water, fine and coarse aggregates, and admixtures. The cementitious materials shall be portland cement, portland cement in combination with pozzolan, or portland cement in combination with ground granulated blast-furnace slag. The admixtures shall be an Air Entraining Admixture, an WRA or an accelerating admixture. A retarding admixture may be used at the request of the Contractor when approved. No other chemical admixtures than those listed above shall be used. For each portion of the structure, mixture proportions shall be selected so that the strength and W/C requirements listed in paragraph: DESIGN REQUIREMENTS are met.

2.2.2 Proportioning Responsibility

The concrete mixtures in the intake structure, below **elevation 545** and the stilling basin invert will be proportioned by the Contracting Officer. All other mixtures will be proportioned by the Contractor. Preliminary mixture-proportioning studies or thermal studies which include mixture proportions are available for review in the District Office. Some mixtures, especially those containing higher amounts of pozzolans, may have slow strength gain which may impact form design and form removal time.

2.2.3 Government-Designed Mixtures

Based on preliminary mix design studies the Government-designed mixtures for use in the mass concrete construction will contain the following approximate amounts of cementitious materials. Final mix designs will be determined using the proposed job materials in accordance with paragraph: Materials for Mixture Proportioning Studies.

2.2.3.1 Mixtures Using Type V and/or Type II Cement in Combination with Fly Ash

Mixtures containing Type V and/or Type II cement shall contain approximately 425 lbs of cement and 215 lbs of fly ash per cubic yard.

2.2.3.2 Mixtures Using Type II Cement in Combination with Granulated Ground Blast Furnace Slag (GGBFS) Cement

Mixtures containing Type II cement in combination with GGBFS shall contain approximately 160 lbs of Type II cement and 360 lbs of GGBFS cement per cubic yard.

2.2.4 Control

The proportions of all material entering into each concrete mixture will be furnished to the Contractor. The proportions will be changed by the Contracting Officer as necessary. Adjustments shall be made by the Contractor to the batch weights of aggregates and water as necessary to compensate for free moisture in the aggregates.

2.2.5 Nominal Maximum-Size of Aggregate

The nominal maximum-size of coarse aggregate to be used in the various parts of the work shall be in accordance with the following tabulation except as directed. The NMSA may be changed for sections requiring a special quality of concrete as directed.

FEATURES	NOMINAL MAXIMUM-SIZE AGGREGATE
Sections 7-1/2 in. or less in width or slabs 4 in. or less in thickness or any section with a clear distance between reinforcement less than 2-1/4 in. ....	3/4 in.
Sections over 7-1/2 in. or slabs at least 4 in. in thickness. However, this size shall not be used in any section in which the clear distance between reinforcement is less than 2-1/4 in. ....	1-1/2 in.

### 2.2.6 Slump

The slump shall be determined in accordance with ASTM C 143 and shall be 2 inches + 1 inch for massive features and between 1 and 4 inches for all others except where placement by pump is approved, in which case the slump shall not exceed 6 inches. In addition, the range of each set of two consecutive tests for each mixture shall be not more than 2 inches. The above specified slump is that required at the forms.

### 2.2.7 Air Content

The air content by volume shall be determined in accordance with ASTM C 143. When the nominal maximum size of coarse aggregate is 1-1/2 inches or larger, the total air content of the sample measured in accordance with ASTM C 231 shall be between 4 and 7 percent. When the nominal maximum-size coarse aggregate is 3/4 inch, the air content shall be between 5 and 7 percent. The specified air content is that required at the forms.

### 2.2.8 Contractor Concrete Proportioning

Trial batches and testing requirements for various qualities of concrete specified shall be the responsibility of the Contractor. Samples of aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by the manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios, which will produce a range of strength encompassing those required for the work. The maximum water-cement ratios required in paragraph: MAXIMUM WATER-CEMENT RATIO will be converted to a weight ratio of water to cement plus pozzolan by mass, or GGBF slag by mass equivalency as described in ACI 211.1. In the case where GGBF slag is used, the weight of the slag shall be included in the equations for the term P, which is used to denote the mass of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent of the total cementitious material. Trial mixtures shall be proportioned for maximum permitted slump and air content with due consideration to the approved conveying and placement method. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 days and at the design age specified in paragraph: DESIGN REQUIREMENTS in accordance with ASTM C 39. From these test results, a curve will be plotted showing the relationship between water-cement ratio and strength.

### 2.2.9 Required Average Compressive Strength

In meeting the strength requirements specified in paragraph: CONCRETE STRENGTH, the selected mixture proportion shall produce a required average compressive strength  $f'_{cr}$  exceeding the specified strength  $f'_c$  by the amount indicated below.

#### 2.2.9.1 Average Compressive Strength from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214. Test records from which a standard deviation is calculated shall represent

materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified strength or strengths (f'c) within 1,000 psi of that specified for proposed work, and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another test age designated for determination of f'c. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'cr = f'c + 1.34S$$

$$f'cr = f'c + 2.33S - 500$$

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS*	MODIFICATION FACTOR FOR STANDARD DEVIATION
less than 15	-**
15	1.16
20	1.08
25	1.03
30 or more	1.00

\* Interpolate for intermediate numbers of tests.

\*\* Use tabulation in paragraph: DETERMINING REQUIRED AVERAGE STRENGTH

#### 2.2.9.2 Average Compressive Strength without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength fcr shall be determined as follows: If the specified compressive strength f'c is less than 3,000 psi,

$$f'cr = f'c + 1,000$$

If the specified compressive strength f'c is 3,000 to 5,000 psi,

$$f'cr = f'c + 1,200$$

If the specified compressive strength f'c is over 5,000 psi,

$$f'cr = f'c + 1,400$$

#### 2.2.10 Color-Conditioned Concrete

The dosage rate of the color admixture used shall be as specified by the manufacturer. The proportions of the other admixtures used shall be adjusted as required to provide a workable concrete mix. A vertical sample panel of adequate size shall be made for approval using the contemplated materials and construction techniques.

#### 2.2.11 Lean Mix Concrete Backfill

Lean mix concrete backfill shall be mixtures of cement, pozzolans, aggregates and water generally prepared with the guidance supplied in ACI Report 229. The mixtures shall be proportioned by the contractor and shall have compressive strengths of 1000 psi at 28 days.

### PART 3 EXECUTION

#### 3.1 EQUIPMENT

##### 3.1.1 Capacity

The batching, mixing, conveying, and placing systems shall have a capacity of at least 100 cubic yards per hour.

##### 3.1.2 Batch Plant

Batch plant shall meet the following requirements.

###### 3.1.2.1 Location

The concrete production plant shall be located at the site of the work in a specific location selected by the Contractor.

###### 3.1.2.2 Bins and Silos

Separate bins, compartments, or silos shall be provided for each size or classification of aggregate and for each of the cementitious materials. The compartments shall be of ample size and so constructed that the various materials will be maintained separately under all working conditions. All compartments containing bulk cement, pozzolan, or ground granulated blast-furnace slag shall be separated from each other by a free-draining air space. All filling ports shall be clearly marked with a permanent sign stating the contents.

###### 3.1.2.3 Batching Equipment

- a. Batchers - Aggregate shall be weighed in separate weigh batchers with individual scales. Bulk cement and/or other cementitious materials shall each be weighed on a separate scale in a separate weigh batcher. Water shall be measured by weight or by volume. If measured by weight, it shall not be weighed cumulatively with another ingredient. Ice shall be measured separately by weight. Admixtures shall be batched separately and shall be batched by weight or by volume in accordance with the manufacturer's recommendations.
- b. Water Batchers - A suitable water-measuring and batching device shall be provided that will be capable of measuring and batching the mixing water within the specified tolerances for each batch. The mechanism for delivering water to the mixers shall be free from leakage when the valves are closed. The filling and discharge valves for the water batcher shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. When a water meter is used, a suitable strainer shall be provided ahead of the metering device.
- c. Admixture Dispensers - A separate batcher or dispenser shall be provided for each admixture. Each plant shall be equipped with the necessary calibration devices that will permit convenient

checking of the accuracy of the dispensed volume of the particular admixture. The batching or dispensing devices shall be capable of repetitively controlling the batching of the admixtures to the accuracy specified. Piping for liquid admixtures shall be free from leaks and properly valved to prevent backflow or siphoning. The dispensing system shall include a device or devices that will detect and indicate the presence or absence of the admixture or provide a convenient means of visually observing the admixture in the process of being batched or discharged. Each system shall be capable of ready adjustment to permit varying the quantity of admixture to be batched. Each dispenser shall be interlocked with the batching and discharge operations so that each admixture is added separately to the batch in solution in a separate portion of the mixing water or in fine aggregate in a manner to ensure uniform distribution of the admixtures throughout the batch during the required mixing period. Storage and handling of admixtures shall be in accordance with the manufacturers recommendations.

- d. Moisture Control - The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched. A moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measurement of moisture in the fine aggregate. The sensing element shall be arranged so that the measurement is made near the batcher charging gate of the fine aggregate bin or in the fine aggregate batcher.
- e. Scales - Adequate facilities shall be provided for the accurate measurement and control of each of the materials entering each batch of concrete. The weighing equipment and controls shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be within 0.2 percent of the scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device. Tests shall be made at the frequency required in paragraph: TESTS AND INSPECTIONS, and in the presence of a Government quality assurance representative. Each weighing unit shall include a visible indicator that shall indicate the scale load at all stages of the weighing operation and shall show the scale in balance at zero load. The weighing equipment shall be arranged so that the concrete plant operator can conveniently observe the indicators.
- f. Operation and Accuracy - The weighing operation of each material shall start automatically when actuated by one or more starter switches and shall end when the designated amount of each material has been reached. These requirements can be met by providing a semiautomatic or automatic batching system as defined by NRMCA CPMB 100. There shall be equipment to permit the selection of 5 preset mixes each by the movement of not more than two switches or other control devices. Cumulative weighing will not be permitted. The weigh batchers shall be so constructed and arranged that the sequence and timing of batcher discharge gates can be controlled to produce a ribboning and mixing of the aggregates, water, admixtures, and cementitious materials as the materials pass through the charging hopper into the mixer. The plant shall include provisions to facilitate the inspection of all operations at all times. Delivery of materials from the batching equipment shall be within the following limits of accuracy:

MATERIAL	PERCENT
Cementitious materials .....	+ 1
Water .....	+ 1
Aggregate smaller than 1-1/2 in. size .....	+ 2
Aggregate larger than 1-1/2 in. size.....	+ 3
Chemical admixtures .....	+ 3

- g. Interlocks - Batchers and mixers shall be interlocked so that:
  - (1) The charging device of each batcher cannot be actuated until all scales have returned to zero balance within  $\pm 0.2$  percent of the scale capacity and each volumetric device has reset to start or has signaled empty.
  - (2) The charging device of each batcher cannot be actuated if the discharge device is open.
  - (3) The discharge device of each batcher cannot be actuated if the charging device is open.
  - (4) The discharge device of each batcher cannot be actuated until the indicated material is within the allowable tolerances.
  - (5) One admixture is batched automatically with the water.
  - (6) Each additional admixture is batched automatically with a separate portion of the water or with the fine aggregate.
  - (7) The mixers cannot be discharged until the required mixing time has elapsed.
  
- h. Recorder - An accurate recorder or recorders shall be provided and shall conform to the following detailed requirements:
  - (1) The recorder shall produce a graphical or digital record on a single visible chart or tape of the weight or volume of each material in the batchers at the conclusion of the batching cycle. The record shall be produced prior to delivery of the materials to the mixer. After the batchers have been discharged, the recorder shall show the return to empty condition.
  - (2) A graphical recording or digital printout unit shall be completely housed in a single cabinet that shall be capable of being locked.
  - (3) The chart or tape shall be so marked that each batch may be permanently identified and so that variations in batch weights of each type of batch can be readily observed. The chart or tape shall be easily interpreted in increments not exceeding 0.5 percent of each batch weight.

- (4) The chart or tape shall show time of day at intervals of not more than 15 minutes.
- (5) The recorder chart or tape shall become the property of the Government.
- (6) The recorder shall be placed in a position convenient for observation by the concrete plant operator and the Government inspector.
- (7) The recorded weights or volumes when compared to the weights or volumes actually batched shall be accurate within  $\pm 2$  percent.
- i. Batch Counters - The plant shall include devices for automatically counting the total number of batches of all concrete batched and the number of batches of each preset mixture.
- j. Rescreening Plant - A rescreening plant shall be located, arranged, and operated in a manner that all coarse aggregate will be routed through the plant and that its operation will ensure delivery to the mixers of graded coarse aggregate free from excessive variation and conforming to the size groups and grading of paragraph: AGGREGATES and with moisture content conforming to the provisions of paragraph: MOISTURE CONTENT. Coarse aggregate may be rescreened and delivered to the batch plant bins one size group at a time or two or more adjacent size groups at a time. Simultaneous rescreening of nonadjacent size groups is not permitted. All material passing the bottom screen of the smallest size of coarse aggregate being screened shall be wasted.
- k. Washing Plant - All coarse aggregates shall be washed immediately prior to entering the rescreening plant. The rewashing plant shall contain adequate water nozzles and vibrating screens to remove foreign materials and coatings from aggregate particles. Water used for washing shall meet the requirements of paragraph: WATER.
- l. Trial Operation - Not less than 7 days prior to commencement of concrete placing, a test of the batching and mixing plant shall be made in the presence of the Contracting Officer to check operational adequacy. The number of full-scale concrete batches required to be produced in trial runs shall be as directed, will not exceed 20, and shall be proportioned as directed. All concrete produced in these tests shall be wasted or used for purposes other than inclusion in structures covered by this specification. All deficiencies found in plant operation shall be corrected prior to the start of concrete placing operations. No separate payment will be made to the Contractor for labor or materials required by provisions of this paragraph. The Contractor shall notify the Contracting Officer of the trial operation not less than 7 days prior to the start of the trial operation.
- m. Protection - The weighing, indicating, recording, and control equipment shall be protected against exposure to dust, moisture, and vibration so that there is no interference with proper operation of the equipment.

#### 3.1.2.4 Laboratory Areas

A room shall be provided in the plant to house the moisture and grading testing equipment for aggregate and to provide working space. Another room shall be provided for testing fresh concrete and for fabricating and initial curing of concrete test specimens in accordance with ASTM C 31. The size, arrangement, and location of these rooms will be subject to approval. The Contractor shall provide electricity, air conditioning, heat, and water as required for use in these laboratory areas. Section 01500 Quality Assurance of these specifications presents requirements for a separate building equipped for a testing laboratory.

#### 3.1.2.5 Plant Layout Drawings

Drawings, in triplicate, showing the layout of the plant the Contractor proposes to use on the work shall be submitted by the Contractor for review. The drawings shall show the locations of the principal components of the construction plant; offices; shop and storage building; housing facilities, if any; and storage areas and yards which the Contractor proposes to construct at the site of the work and elsewhere. The Contractor shall also furnish for review drawings, in triplicate, showing the general features of his aggregate processing plant; aggregate transporting; storage and reclaiming facilities; aggregate rinsing and dewatering plant, if required; coarse aggregate rescreening plant, if required; concrete batching and mixing plant; concrete conveying and placing plant; and when precooling of concrete is required, the cooling plant. The drawing shall appropriately show the capacity of each major feature of the plant including the rated capacity of the aggregate production plant in tons per hour of fine and coarse aggregates; rated capacity of the aggregate transporting, storage and reclaiming facilities; volume of aggregate storage; capacity of cement and pozzolan storage; rated capacity of the concrete batching and mixing plant in cubic yards per hour; rated capacity of the concrete transporting and placing plant in cubic yards per hour; and when used rated capacity of plant for precooling of concrete. Drawings in triplicate showing any changes in plant made during design and erection or after the plant is in operation shall be submitted for review. Two sets of the drawings will be retained and one set will be returned to the Contractor with comments. Final drawings incorporating final comments and any changes made during operation of the plants will be supplied to the Government on drawings in an electronic media format acceptable to the Contracting Officer.

#### 3.1.3 Mixers

Mixers shall be stationary mixers. Each mixer shall combine the materials into a uniform mixture and discharge this mixture without segregation. Mixers shall not be charged in excess of the capacity recommended by the manufacturer on the nameplate. Excessive over-mixing requiring introduction of additional water will not be permitted. The mixers shall be maintained in satisfactory operating condition, and mixer drums shall be kept free of hardened concrete. Mixer blades or paddles shall be replaced when worn down more than 10 percent of their depth when compared with the manufacturer's dimension for new blades. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired or replaced. The size of the batch, the mixing time, the charging sequence, and other factors identified by the contractor shall be adjusted to provide concrete that meets the uniformity limits specified herein. All testing shall be performed in accordance with COE CRD-C 55. When regular testing is performed, the concrete shall meet the limits of

any five of the six uniformity requirements. When abbreviated testing is performed, the concrete shall meet only those requirements listed for abbreviated testing. The initial mixer evaluation test shall be a regular test and shall be performed prior to the start of concrete placement. The concrete proportions used for the evaluation shall contain the largest size aggregate on the project and shall be as directed. Regular testing shall consist of performing all six tests on three batches of concrete. The range for regular testing shall be the average of the ranges of the three batches. Abbreviated testing shall consist of performing the three required tests on a single batch of concrete. The range for abbreviated testing shall be the range for one batch. If more than one mixer is used and all are identical in terms of make, type, capacity, condition, speed of rotation, etc., the results of tests on one of the mixers shall apply to the others, subject to approval. Mixer evaluations shall be performed by the Contractor in accordance with paragraph: MIXER UNIFORMITY. However, the initial evaluation will be performed by the Government. The Contractor shall provide labor and equipment as directed to assist the Government in performing any evaluation made by the Government.

PARAMETER	REGULAR TESTS ALLOWABLE MAXIMUM RANGE FOR AVERAGE OF 3 BATCHES	ABBREVIATED TESTS ALLOWABLE MAXIMUM RANGE FOR 1 BATCH
Unit weight of air-free mortar, lb/cu ft	2.0	2.0
Air content, percent	1.0	---
Slump, inches	1.0	---
Coarse aggregate, percent	6.0	6.0
Compressive strength at 7 days, percent	10.0	10.0
Water content, percent	1.5	---

#### 3.1.4 Sampling Facilities

##### 3.1.4.1 Concrete

The Contractor shall provide suitable facilities and labor for obtaining representative samples of concrete in accordance with ASTM C 172 for Contractor quality control (QC) and Government quality assurance (QA) testing.

##### 3.1.4.2 Coarse Aggregate

Suitable facilities shall be provided for readily obtaining representative samples of coarse aggregate for test purposes immediately prior to the material entering the mixer.

##### 3.1.5 Transporting Equipment

Transporting equipment shall be designed, operated, and maintained so that it does not cause or permit segregation or loss of material. The concrete shall not be dropped vertically more than 5 feet except where suitable

equipment is provided to prevent segregation and where specifically authorized.

#### 3.1.5.1 Buckets

Bottom-dump buckets shall conform to the following requirements: the interior hopper slope shall be not less than 70 degrees from the horizontal; the minimum dimension of the clear gate opening shall be at least five times the nominal maximum size of the aggregate, and the area of the gate opening shall not be less than 2 square feet; the bucket gates shall be grout-tight when closed, shall be of the double clamshell type, and shall be manually, pneumatically, or hydraulically operated; and the gate-opening mechanism shall be designed to close the gates automatically when the control is released or when the air or hydraulic line is broken. If gate actuation is dependent on integral air or hydraulic reservoirs, the capacity of the reservoirs shall be sufficient to open and close the gates three times without recharging the reservoir.

#### 3.1.5.2 Trucks

Truck mixers or agitators used for transporting central-mixed concrete shall conform to the applicable requirements of ASTM C 94. Truck mixers shall not be used to transport concrete with larger than 1-1/2 inch nominal maximum-size aggregate or 2 inch or lower slump. Nonagitator trucks may be used for transporting central-mixed concrete over a smooth road when the hauling time is less than 15 minutes and the slump is less than 3 inches. Bodies of nonagitator trucks shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

#### 3.1.5.3 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitator truck, the chutes supplied by the truck manufacturer as standard equipment may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment shall not be permitted for conveying concrete except when specifically approved and in no case shall slump be increased to accommodate their use.

#### 3.1.5.4 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer or delivery truck to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete or loss of mortar at the transfer point(s) and the point of placing. The idler spacing shall not exceed 36 inches. Belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. Belt width shall be a minimum of 16 inches if the NMSA is 3 inches or less. The NMSA required in mixture proportions furnished by the Government will not be changed to accommodate the belt width.

#### 3.1.5.5 Pump Placement

Concrete may be conveyed by positive-displacement pump when approved. Pump placement will be approved only for areas where placement by bucket or conveyor is difficult or impractical. The pumping equipment shall be

piston or squeeze-pressure type. The pipeline shall be rigid-steel pipe or heavy-duty flexible hose. Aluminum pipe shall not be used. The inside diameter of the pipe shall be at least 3 times the nominal maximum size of the coarse aggregate in the concrete to be pumped but not less than 4 inches.

### 3.2 PREPARATION FOR PLACING

#### 3.2.1 Vibrators

An adequate number of vibrators shall be on hand to meet placing requirements, and spare vibrators shall be available to maintain production in the event of breakdown. There shall be adequate air pressure available for air vibrators and adequate voltage for electric vibrators. Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed in conformance with the following requirements:

APPLICATION	HEAD DIAMETER INCHES	FREQUENCY VPM	AMPLITUDE INCHES
Thin walls, beams, etc.	1-1/4 - 2-1/2	9,000 - 13,500	0.020 - 0.04
General construction	2 - 3-1/2	8,000 - 12,000	0.025 - 0.05
Heavy sections	3 - 6	7,000 - 10,500	0.030 - 0.06
Mass concrete	5 - 7	5,500 - 8,500	0.040 - 0.08

The frequency and amplitude shall be within the range indicated in the tabulation as determined in accordance with paragraph: TESTS AND INSPECTIONS.

#### 3.2.2 Embedded Items

Before placing concrete, care shall be taken to determine that all embedded items are securely fastened in place as indicated in the drawings or required. Embedded items shall be free of oil and other foreign matter such as loose coatings of rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Any air or water lines or other materials embedded in structures as authorized construction expedients shall conform to the above requirements and upon completion of their use shall be backfilled with concrete or mortar as directed. Welding will not be permitted on embedded or otherwise exposed metals which are in contact with concrete surfaces. Tack welding of or to embedded items will not be permitted.

#### 3.2.3 Concrete on Earth Foundations

Earth foundations upon which concrete is to be placed shall be clean, damp, and free from frost, ice, and standing or running water. Prior to placement of concrete, the earth foundation shall have been satisfactorily compacted in accordance with the provisions of Sections 02212 Embankment or 02250 Fills and Subgrade Preparation, as applicable.

#### 3.2.4 Concrete on Rock Foundations

Rock surfaces upon which concrete is to be placed shall be clean and free from oil, standing or running water, ice, mud, drummy rock, coatings, debris, and loose, semidetached, overhanging, or unsound fragments. Faults or joints shall be cleaned to a satisfactory depth and to firm rock on the sides as directed by the Contracting Officer. Immediately before concrete

is placed, all rock surfaces shall be cleaned thoroughly by the use of air-water jet, high-pressure water jet, or sandblasting as described in paragraph: CONSTRUCTION JOINT TREATMENT. All rock surfaces shall be kept continuously wet for at least 24 hours immediately prior to placing concrete thereon. All approximately horizontal surfaces shall be covered immediately before the concrete is placed with a 1/2 inch layer of mortar composed of the same sand and cementitious materials used in the concrete. The sand-cementitious materials ratio and the water-cementitious material ratio of the mortar shall be approximately the same as those used in the concrete mixture. The mortar shall be covered with concrete before the mortar has reached its initial time of setting.

### 3.2.5 Construction Joint Treatment

#### 3.2.5.1 Joint Preparation

Concrete surfaces to which other concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning by sandblasting, high-pressure water jet, or air-water cutting. Surface cutting by air-water jets will not be permitted for concrete surfaces congested with reinforcing steel or if they are relatively inaccessible. If, for any other reason, it is considered undesirable to disturb the surface of a lift before it has hardened, the use of sandblasting or high-pressure water jet after hardening will be required. Regardless of the method used, the resulting surface shall be free from all laitance and inferior concrete so that clean, well-bonded coarse aggregate particles are exposed uniformly over the lift surface. Application of the joint treatment method shall be such that the edges of the larger particles of aggregate are not undercut. Where joint preparation occurs more than 2 days prior to placing the next lift or where the work in the area subsequent to the joint preparation causes dirt or debris to be deposited on the surface, the surface shall be cleaned as the last operation prior to placing the next lift. The surface of the construction joint shall be kept continuously wet for the first 12 hours of the 24 hours prior to placing concrete, except that the surface shall be damp with no free water at the time of placement.

#### 3.2.5.2 Air-Water Cutting

Air-water cutting of a construction joint shall be performed at the proper time, generally between 4 and 12 hours after placement and only on horizontal construction joints. This period may be modified if a retarder is used to prolong the setting of the cement at surface of the concrete. The air pressure used in the jet shall be 90 to 110 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, the Contractor shall furnish samples of the material to be used and shall demonstrate the method to be used in its application. After cutting, the surface shall be washed and rinsed until the wash water is no longer cloudy. If air-water cutting does not produce acceptable results, the surface shall be prepared by high-pressure water jet or sandblasting.

#### 3.2.5.3 High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi may be used for cleaning. Its use shall be delayed until the concrete is sufficiently

hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the high-pressure water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

#### 3.2.5.4 Wet Sandblasting

This method of joint preparation may be used when the concrete has reached sufficient strength to prevent undercutting of coarse aggregate particles. The operation shall be continued until all accumulated laitance, coatings, stains, debris, and foreign materials are removed. The surface of the concrete shall then be washed thoroughly to remove all loose material. This method may be used on both horizontal and vertical surfaces.

#### 3.2.5.5 Waste Water Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall meet all requirements of Section 01430 Environmental Protection.

#### 3.2.6 Form Checkout Card System

A standardized form checkout card system will be used for maintaining the recorded control of the performance of concrete work under this contract. Prior to placing any lift of concrete in any structure, all items of work in the lift including but not limited to foundations, drainage, forms, reinforcing steel, mechanical, electrical, cleanup, and safety requirements will be checked by the Government for compliance with plans, specifications, approved construction methods and approved lift drawings. A final clearance signature on the checkout card must be obtained from the Contracting Officer before commencing placement of concrete in each placement. This checkout method will not relieve any responsibility for ascertaining that all preparatory work and all clearance does not relieve the Contractor of the responsibility for any errors, omissions, or work not meeting the requirements of the plans and specifications. All screeds shall be checked and rechecked as the placement is topped out.

### 3.3 TRANSPORTING AND PLACING

#### 3.3.1 Transporting

Methods and equipment for conveying and depositing the concrete into the form shall be subject to approval. The capacity of the transporting system shall be sufficient to supply concrete at a rate to prevent cold joints forming during placement. A properly designed and sized elephant trunk and rigid drop chute bottom section which will prevent free-fall within the elephant trunk and rigid drop chute will be used if concrete is to drop more than 5 feet. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the concrete shall discharge into a pipe or elephant trunk that is long enough to extend through the reinforcing bars to within 5 feet of the placing surface. In no case will concrete be discharged to free fall through the reinforcing bars.

##### 3.3.1.1 Transporting by Bucket

There shall be provided indicating and signaling devices for the control of identification of types or classes of concrete as they are mixed and

discharged into buckets for transfer to the forms. Each type or class of concrete shall be visually identified by placing a colored tag or marker on a bucket as it leaves the mixing plant so that the concrete may be positively identified in the forms and placed in the structure in the desired position.

#### 3.3.1.2 Transporting by Pump

The nominal maximum-size coarse aggregate will not be reduced or mixture proportions changed to accommodate a pump except as specifically determined appropriate. The distance and height to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation the equipment shall be thoroughly cleaned and flushing water shall be wasted outside the forms.

#### 3.3.1.3 Transporting by Belt Conveyor

Methods and equipment for transporting the concrete by belt conveyor into the form shall be subject to approval.

#### 3.3.2 Placing

The capacity of the placing system shall be sufficient to supply concrete at a rate which will prevent cold joints in any placement. Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the material to segregate. Concrete shall be deposited as close as possible to its final position in the forms, and in so depositing, there shall be no vertical drop greater than 5 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 placed and consolidated in horizontal layers not exceeding 5 feet in thickness with a minimum of lateral movement. The amount of concrete deposited shall be such that it can be readily and thoroughly consolidated and shall not exceed 4 cubic yards in one pile. All concrete-placing equipment and methods shall be subject to approval. Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement and consolidation.

Drop chutes, elephant trunks, and/or tremies should be used in walls and columns to prevent free-fall of the concrete and to allow the concrete to be placed through reinforcing steel. They should be moved at short intervals to prevent stacking of concrete. Vibrators should be used to move the mass of concrete through the forms.

Flowable fill placement shall be balanced such that the placement of flowable fill shall not be greater than 5 feet above the placement of any other fill on opposite sides of the structure against which the flowable fill is being placed.

##### 3.3.2.1 Time Interval Between Mixing and Placing

Concrete mixed in stationary mixers and transported by nonagitating equipment shall be placed within 30 minutes after it has been mixed, unless otherwise authorized. When concrete is truck mixed or when a truck mixer or agitator is used for transporting concrete mixed by stationary mixers, the concrete shall be delivered to the site of the work, and discharge

shall be completed within 1-1/2 hours after introduction of the cement to either the water or aggregate.

3.3.2.2 Hot-Weather Placing

The temperature of the concrete when deposited in the forms during hot weather shall not exceed 85 degrees F except as further required by paragraph: TRANSPORTING AND PLACING and Special Temperature Controlled Concrete. An approved retarding admixture may be used in accordance with paragraph: MATERIAL SPECIFICATION to facilitate placing and finishing. Steel forms and reinforcement and conveying and placing equipment shall be cooled if necessary to assist in maintaining specified concrete-placing temperature. The temperature of the fresh concrete shall be measured in accordance with ASTM C 1064.

3.3.2.3 Cold Weather Placing

The temperature of the concrete when deposited in the forms shall not be less than 40 degrees F. The ambient temperature of the placement area and all surfaces to receive concrete shall be above 32 degrees F. Materials entering the mixer shall be free from ice, snow, and frozen lumps. The heating of mixing water or aggregates necessary to keep the concrete temperature above 40 degrees F shall be closely regulated so that the concrete temperature does not exceed 60 degrees F. An accelerator may be used when approved in advance.

3.3.2.4 Special Temperature-Controlled Concrete

Special temperature control is applicable to mass concrete placements in the elements indicated in the table below. Regardless of the requirements specified above, the concrete shall have a temperature not exceeding that specified below and not less than 40 degrees F, when measured at least 20 minutes after mixing. Heating of the mixing water or aggregates will not be permitted until the temperature of the concrete has decreased to 45 degrees F. The materials shall be heated in such a manner that they will be free from ice, snow, and frozen lumps before entering the mixer.

Structural Element	Maximum Placing Temperature (Degrees F)	
	Low Heat Mixtures	High Heat Mixtures
Intake Structure Below Elevation 470 (Sta 9+10 to Sta 10+00)	65	55
Intake Structure Above Elev 470 and Below Elevation 545 (Sta 9+10 to Sta 10+00)	70	60
Stilling Basin Invert Between Sta 18+13.40 and Sta Sta 21+02.50	65	55

The following methods may be used for cooling plastic concrete:

- (1) Precooling of aggregates by screening from direct sunlight, spraying with chilled water, and (if required) sending the aggregates through a chilling system just prior to batching.

(2) Using chilled water for mixing or substituting up to 50 percent by weight of ice for mixing water. Replacement rates greater than 50 percent will require test batches to confirm that mixing and uniformity requirements are met prior to use in the construction. Additionally, test batches to confirm concrete quality will be prepared by the contractor, at no cost to the government, prior to use of concrete with replacement of more than 50 percent of the free water by ice.

(3) Liquid nitrogen cooling of the concrete mixture by (a) injection of liquid nitrogen into the mixer after completion of batching and mixing, and (b) mixing liquid nitrogen with parts of the aggregate prior to batching and mixing.

#### 3.3.2.5 Concrete Lifts

The depth of concrete placed in each lift will be as shown in the drawings.

All concrete shall be deposited in approximately horizontal layers about 1-1/2 feet in thickness in stepped progression at such a rate that the formation of cold joints will be prevented. Slabs shall be placed in one lift, unless 2-1/2 foot or more deep. Where 7-1/2 foot or greater lift depths are permitted, the Contractor shall furnish approved cantilever forms that are jointed or hinged approximately midheight to facilitate placement against surfaces sloping more than 10 degrees from vertical. At the beginning of the placing of a lift, the top half of a hinged or jointed form shall be retracted to such a position that it does not interfere with the operation of buckets placing concrete adjacent to the form. A minimum of five successive horizontal layers in stepped progression shall be used for 7-1/2 foot lifts. Where 5 foot lifts are required, a minimum of three successive horizontal layers in stepped progression shall be used. Each new layer of concrete shall be placed on the oldest exposed layer. The maximum exposed bulkhead face of concrete between adjacent monoliths shall not exceed 40 feet except as otherwise approved.

#### 3.3.2.6 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrating equipment. Vibrators shall not be used to cause concrete to flow for significant distances within the forms. Hand spading may be used if necessary together with internal vibration along formed surfaces permanently exposed to view. Form vibrators shall not be used. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding unhardened layer if such exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly. Slabs 8 inches or less in depth shall be consolidated by approved methods.

### 3.4 FINISHING

#### 3.4.1 Finish Requirements

##### 3.4.1.1 High Velocity Finish

A high velocity (HV) finish shall be required on all concrete surfaces exposed to high velocity flow (40 fps) from Station 9+40 to Station

20+84.50.

#### 3.4.1.2 Permanent View Finish

A permanent view (PV) finish shall be required for all surfaces that do not require HV finish or do not have backfill placed against them as shown.

#### 3.4.2 Unformed Surfaces

##### 3.4.2.1 General

The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 40 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour, provisions for windbreaks, shading, fog spraying, or evaporation retarding film shall be made in advance of placement to prevent plastic shrinkage cracks, and such protective measures shall be taken before, during, and immediately after finishing as operations require. All unformed surfaces of concrete that are not to be covered by additional concrete or backfill shall have a float finish, unless a trowel finish is specified, and shall be true to elevation as shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. The concrete shall be thoroughly consolidated before finishing operations commence or before leaving it for future concrete or backfill placement.

##### 3.4.2.2 Float Finish

Surfaces to receive a float finish shall be screeded and darried or bullfloated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be of aluminum or magnesium. After the water sheen has disappeared, the concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true even plane.

##### 3.4.2.3 Trowel Finish

A hard steel trowel shall be applied to all unformed surfaces requiring HV finish. Concrete surfaces shall first be given a float finish. After surface moisture has disappeared, the surface shall be troweled to a smooth, even, dense finish, free from blemishes, including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Surfaces or edges likely to be injured during the construction period shall be protected from damage.

##### 3.4.2.4 Broom Finish

A broom finish shall be applied as indicated on the drawings. The concrete surface to be broom finished shall first be given a float finish. The surface shall then be broomed with a stiff fiber-bristle broom in a

direction transverse to that of the traffic.

3.4.2.5 Bridge Decks

The Contractor shall set elevation control points, to be approved by the Contracting officer, which shall be used to establish the grade and cross section of the concrete deck surface. A tight wood float finish shall be provided on the surface of the bridge deck where excessive surface working will not be permitted. The exposed concrete surfaces shall be broomed in a transverse direction with a fine textured hair push broom to produce a uniform surface texture and eliminate float marks or shall be finished using an alternative method approved by the Contracting Officer achieving a similar surface texture. Brooming, shall be done when the surface is sufficiently set to prevent deep scaring. If directed by the Contracting Officer, a fine spray of water shall be applied to the surface immediately in advance of brooming.

3.4.3 Formed Surface Repair

3.4.3.1 General

Within 4 hours after removal of forms all ridges or lips shall be removed and undesirable local bulging on the surfaces to be permanently exposed shall be remedied. Concrete formwork requirements for the classes of finish specified are covered in SECTION: FORMWORK FOR CONCRETE. Epoxy bonding agent shall be in accordance with ACI 503.2. Latex bonding agent meeting the requirements of ASTM C 1059 may be used instead of epoxy resin if concrete to be patched was placed less than 24 hours previously.

3.4.3.2 High Velocity (HV) Finish

All defective areas (imperfections, voids, honeycomb, rock pockets, bug holes negative surface irregularities, etc...) shall be repaired as shown below:

SIZE	REMOVAL	PATCHING
1/4 to 1 inch in diameter (and holes left by removal of form tie rods)	Reamed or chipped to a roughened surface	Epoxy bonding agent dry packed mortar
1 inch diameter to 16 square inches	Reamed, chipped or cut to a minimum depth of 3 inches	Epoxy bonding agent dry packed mortar or concrete
Areas exceeding 16 square inches	Dove-tailed saw cuts to a depth of 3 inches in a rectangular pattern and chipped 1 inch past reinforcement or 6 inches total	Epoxy bonding agent concrete (saw cuts that extend past corners shall be patched with dry-packed mortar)

NOTES: Grinding to meet tolerance is acceptable only if in accordance with paragraph: Surface Requirements

Patch tolerances are smaller and are critical for HV patch and nearby concrete stability. The finished patch shall be flush at the edges and its surface shall not vary by more than 1/16 inch or it shall be removed and redone.

#### 3.4.3.3 Permanent View (PV) Finish

The surfaces of specified exterior formed concrete permanently exposed to view shall meet the following requirements: defective areas, voids, honeycomb, and bug holes which exceed 1/2-inch in diameter and holes left by removal of form tie rods shall be reamed or chipped and filled with dry pack mortar. Defective and unsound concrete areas larger than 36 square inches and deeper than 2 inches shall be outlined by saw cuts at least 1 inch deep in an approved rectangular pattern, the defective concrete removed, and repaired with concrete replacement as specified in paragraph: Material and Procedure for Repairs. The prepared area shall be brush-coated with an approved epoxy resin or with a neat cement grout after dampening and then filled with mortar or concrete.

#### 3.4.3.4 All Other Formed Surfaces

After removal of forms, areas of honeycomb or voids which exceed 4 inches in diameter shall be reamed or chipped and filled with dry pack mortar. Defective and unsound areas larger than 48 square inches and deeper than 2 inches shall be removed by saw cuts in a rectangular pattern and repaired with concrete replacement as specified in paragraph: Material and Procedure for Repairs. The prepared area shall be brush-coated with an approved epoxy resin or with a neat cement grout after dampening and then filled with mortar or concrete.

#### 3.4.3.5 Material and Procedure for Repairs

The cement used in the dry-pack mortar or replacement concrete shall be a blend of the cement utilized for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be utilized to determine the proportions required to match colors. Dry-pack mortar shall consist of 1 part cement to 2-1/2 parts fine aggregate. The fine aggregate shall be that utilized for production of project concrete. The mortar shall be remixed without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc., and struck off to adjacent concrete. Replacement concrete shall be produced utilizing project materials to meet requirements of the concrete it is replacing, and shall be proportioned by the Contractor and approved by the Contracting Officer. It shall be drier than the usual mixtures and shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc., and shall be struck off and finished to adjacent concrete. Forms shall be utilized as required or as directed. Metal tools shall not be used to finish permanent view (PV) surfaces. The repaired areas shall be cured for 7 days. The temperature of the in-situ concrete, adjacent air and replacement mortar or concrete shall be above 50 degrees F during placement, finishing, and curing. Packaged materials meeting the requirements of ASTM C 928 may be used in lieu of dry-pack mortar when approved.

#### 3.4.4 Toilet Room Finish

Tilework shall be laid out to minimize cuts less than one half the tile in

size. Wall and floor tiles shall be aligned to give straight uniform grout lines. Tiles shall be set in portland cement mortar, and grout manufacturer's recommendations shall be followed as to grouting procedures and precautions.

### 3.5 CURING AND PROTECTION

#### 3.5.1 Curing Time

All concrete shall be cured by one of the following methods or combination of methods for the period of time given below corresponding to the cementing materials used in the concrete:

Type III portland cement .....	3 days
Type II portland cement .....	14 days
Portland cement blended with 25 percent or less fly-ash or GGBF slag .....	14 days
Portland cement blended with more than 25 percent fly-ash or GGBF slag .....	21 days

Curing shall begin immediately after placing. The Contractor shall have all equipment needed for adequate curing and protection of the concrete on hand and ready to install before actual concrete placement begins. The curing medium and method, or the combination of media and methods used, shall be as approved in accordance with paragraph: SUBMITTALS, SD-08 Statements, submittal item "Curing".

#### 3.5.2 Moist Curing

Horizontal and nearly horizontal surfaces shall be moist cured by ponding, by covering with a minimum uniform thickness of 2 inches of continuously saturated sand, or by covering with saturated nonstaining burlap or cotton mats. Burlap and cotton mats shall be rinsed to remove soluble substances before using. Other surfaces shall be moist cured when approved or directed. Concrete that is moist cured shall be maintained continuously, not periodically, wet for the duration of the entire curing period. Water for curing shall comply with the requirements of the paragraph: WATER. If the water, sand, mats, etc. cause staining or discoloration of permanently exposed concrete surfaces, the surfaces shall be cleaned by a method approved. When wood forms are left in place during curing, the forms shall be kept continuously wet except for sealed insulation curing in cold weather. When steel forms are left in place on vertical surfaces during curing, the forms shall be carefully broken loose from the hardened concrete and curing water continuously introduced into the void. Horizontal construction joints shall be allowed to dry sufficiently to remove free water immediately prior to placing the next lift.

#### 3.5.3 Membrane Curing

##### 3.5.3.1 Materials

Membrane curing may be used on surfaces that are not specified or directed to receive moist curing and that are not to receive a grout-cleaned finish. Membrane-forming curing compound shall not be used on surfaces that contain protruding steel reinforcing, that are heated by free steam, that will have additional concrete bonded to them, or that are to be grout-cleaned. Compound conforming to ASTM C 309, Type 2, Class A, may be used on surfaces

that will not be exposed to view when the project is completed. Only pigmented compound of the styrene acrylate or chlorinated rubber formulation conforming to ASTM C 309, Class B, requirements may be used on surfaces that are to be painted or to receive bituminous roofing or water proofing or floors that are to receive adhesive applications of resilient flooring. The curing compound selected by the Contractor for such use shall be compatible with any subsequent paint, roofing, coating, or flooring specified elsewhere in the contract.

#### 3.5.3.2 Application

The curing compound shall be applied to formed surfaces immediately after the forms are removed. The surfaces shall be thoroughly moistened with water, and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared provided steps have been taken when necessary to prevent premature loss of free water due to excessive evaporation as described in paragraph: UNFORMED SURFACES. The curing compound shall be applied in a two-coat continuous operation by motorized power-spraying equipment or pressure-tank equipment operating at a minimum pressure of 75 psi with provisions for continuous agitation. The application equipment shall be approved in advance. Hand-operated pressure applicators ("garden sprayers") shall not be used except in small, isolated areas as approved. The compound shall be applied at a uniform coverage of not more than 400 square feet per gallon for each coat. The second coat shall be applied perpendicular to the first coat. Concrete surfaces that have been subjected to rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified. All concrete surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other influence that will disrupt the continuity of the curing membrane.

#### 3.5.4 Sheet Curing

Sheets shall be used only on horizontal or near horizontal surfaces. The sheets shall comply with the requirements of ASTM C 171, except that polyethylene sheet shall not be used. All surfaces shall be thoroughly wetted and completely covered with waterproof paper, or polyethylene-coated burlap. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

#### 3.5.5 Curing Color-Conditioned Concrete

In order to achieve color uniformity proper curing materials as recommended by the color additive manufacturer shall be used.

#### 3.5.6 Protection

No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. No vibratory earth compaction equipment or pile-driving equipment shall be operated within 100 feet horizontally of concrete less than 5 days old. Blasting shall not be permitted within 100 feet horizontally of concrete less than 90 days old. Blasting plans shall

be approved by the Contracting Officer. All galleries, conduits, and other openings through the concrete shall be kept closed or sealed during the entire construction period. The surface of the concrete shall be protected from rain or snow during placing.

### 3.6 BASE PLATES AND BEARING PLATES

#### 3.6.1 Setting of Plates

After being plumbed and properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be provided full bearing using Nonshrink grout. The space between the top of the concrete bearing surface and the bottom of the plate shall not be less than 1/24 of the width of the plate or 1/2 inch, whichever is greater. Concrete surfaces shall be clean, free of oil, grease, and laitance, and shall be damp. Metal surfaces shall be clean and free of oil, grease, and rust.

#### 3.6.2 Nonshrink Grout

Nonshrink grout shall conform to the requirement of paragraph: MATERIAL SPECIFICATION. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

##### 3.6.2.1 Mixing and Placing

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be sized to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or masonry bearing surface and the plate shall be filled with the grout. Forms shall be of wood or other suitable material for retaining the grout and shall be removed after the grout has hardened. If Grade "A" grout is used, all surfaces, including top surfaces, shall be formed to provide restraint. The placed grout shall be worked to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be made under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

##### 3.6.2.2 Treatment of Exposed Surfaces

Those types of grout containing metallic aggregate, Grade B or C grout, shall, after setting, have exposed surfaces under cut back 1 inch from the edge of the base plate and immediately covered with a thick coat of mortar proportioned by weight of one part portland cement, two parts sand, and sufficient water to make the mixture placeable. The parge coat shall have a smooth, dense finish. The exposed surface of other types of nonshrink grout shall have a smooth, dense finish.

##### 3.6.2.3 Curing

Grout and parge coats shall be cured in conformance with paragraph: CURING AND PROTECTION.

### 3.7 BLOCK-OUT CONCRETE

#### 3.7.1 Composition and Proportions

Block-out concrete shall be composed of portland cement, water, fine and coarse aggregate, and admixtures. The concrete mixture proportions, including admixture, will be provided by the Contracting Officer. An expansive admixture shall be used to cause the blockout concrete to expand to fit snugly in the space that confines it. The expansive admixture shall conform to the requirements of ASTM C 937 for grout fluidifier. Any block-out concrete not placed within 30 minutes after contact of the cement and admixture shall be wasted. The block-out shall be confined on all sides to provide restraint.

#### 3.7.2 Placing Block-out Concrete

Blockouts shall be provided as shown on the plans for the embedment of gate seal seats, gate guides, bulkhead guides, beams embedded for bulkhead seals, crane rails, and other embedded metalwork as appropriate. Prior to installation of embedded items, the block-outs or recesses shall be cleaned in accordance with applicable requirements of the paragraph on construction joint treatment. After installation of embedded items and prior to placing any forms, all surfaces of the block-outs or recesses and surfaces of items to be embedded shall be thoroughly cleaned of all loose material, oil, grease, and other contaminants which might reduce the bond between the surfaces of the blockouts or recesses and new concrete. Extreme caution shall be exercised in placing block-out concrete to avoid distortion or displacement of the embedded items.

### 3.8 TESTS AND INSPECTIONS

#### 3.8.1 General

The Contractor shall perform the following inspection and tests as described, and, based upon the results of these inspections and tests, he shall take the action required and submit reports as required. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease. The laboratory performing the tests shall be on-site and shall conform with the requirements given in ASTM C 1077. The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077. The individual who performs the inspection shall have demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Construction Inspector, Level II.

#### 3.8.2 Testing and Inspection Requirements

##### 3.8.2.1 Fine Aggregate

- a. Grading - At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 , ASTM C 117 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or

classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. The results shall be recorded on a sheet on which are also shown the specification limits applicable to the project.

- b. Fineness Modulus Control Chart - Results for fineness modulus shall be grouped in sets of three consecutive tests, and the average and range of each group shall be plotted on a control chart. The upper and lower control limits for average shall be drawn 0.10 units above and below the target fineness modulus, and the upper control limit for range shall be 0.20 units above the target fineness modulus.
- c. Corrective Action for Fine Aggregate Grading - When the amount passing any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure for any sieve, the fact shall immediately be reported. Whenever a point on the fineness modulus control chart, either for average or range, is beyond one of the control limits, the frequency of testing shall be doubled. If two consecutive points are beyond the control limits, the process shall be considered out of control and concreting shall be stopped. Notify the Contracting Officer, and take immediate steps to rectify the situation. After two consecutive points have fallen within the control limits, testing at the normal frequency may be resumed.
- d. Moisture Content Testing - When in the opinion of the Contracting Officer the electric moisture meter is not operating satisfactorily, there shall be at least four tests for moisture content in accordance with ASTM C 566 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When an electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content shall be used to adjust the added water in the control of the batch plant.
- e. Moisture Content Corrective Action - Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device).

#### 3.8.2.2 Coarse Aggregate

- a. Grading - At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt

limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When facilities are available to test samples five times as large as those required in ASTM C 136, no averaging shall be done.

- b. Corrective Action for Grading - When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported. Where two consecutive averages of five tests (or two consecutive tests where large samples are used) are outside specification limits, the operation shall be considered out of control, and that fact shall be reported, concreting shall be stopped, and immediate steps shall be taken to correct the grading.
- c. Coarse Aggregate Moisture Content - A test for moisture content of each size group of coarse aggregate shall be made at least once a shift. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified previously for fine aggregate.
- d. Coarse Aggregate Moisture Corrective Action - Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted to compensate for this.
- e. Particle Shape Testing - When directed, a problem exists in connection with aggregate particle shape, tests shall be made in accordance with ASTM D 4791. Testing frequency shall be not less than one per day, when directed.
- f. Particle Shape Corrective Action - When testing for particle shape is required, two consecutive failures in the same sieve size shall be immediately reported, who shall determine what corrective action is needed.
- g. Material Finer than the No. 200 Sieve - When in the opinion of the Contracting Officer, a problem exists in connection with the cleanliness of aggregate, tests shall be made in accordance with ASTM C 117. Testing frequency shall be as directed.
- h. Corrective Action for Material Finer than the No. 200 Sieve - When material finer than the No. 200 sieve exceeds 1.0 percent of the weight of the aggregate finer than 1-1/2 inches or 0.5 percent of the weight of the aggregate coarser than 1-1/2 inches, the Contracting Officer shall be notified and steps, such as washing or other corrective action, shall be initiated immediately.

#### 3.8.2.3 Quality of Aggregates

- a. Frequency of Quality Tests - Prior to submitting samples for mixture proportioning studies and 30 days prior to the start of concrete placement, the Contractor shall perform the tests for aggregate quality in the following list. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality in accordance with the following frequency schedule. Samples tested after the start of concrete placement

shall be taken immediately prior to entering the concrete mixer.

PROPERTY	FREQUENCY		TEST
	FINE AGGREGATE	COARSE AGGREGATE	
Specific Gravity	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Absorption	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Clay Lumps and Friable Particles	Every 3 months	Every 3 months	ASTM C 142
Material Finer than the No. 200 Sieve	Every 3 months	Every 3 months	ASTM C 117
Organic Impurities	Annually	Not applicable	ASTM C 40
L.A. Abrasion	Not applicable	Every 6 months	ASTM C 131 ASTM C 535

- b. Corrective Action for Aggregate Quality - If the result of a quality test fails to meet the requirements for quality during submittal of samples for mixture-proportioning studies or immediately prior to start of concrete placement, production procedures or materials shall be changed and additional tests shall be performed until the material meets the quality requirements prior to proceeding with either mixture-proportioning studies or starting concrete placement. After concrete placement commences, whenever the result of a test for quality fails the requirements, the test shall be rerun immediately. If the second test fails the quality requirement, the fact shall be reported and immediate steps taken to rectify the situation.

#### 3.8.2.4 Scales

- a. Weighing Accuracy - The accuracy of the scales shall be checked by test weights at least once a month for conformance with the applicable requirements of paragraph: EQUIPMENT. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors.
- b. Batching and Recording Accuracy - Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. The Contractor shall confirm that the calibration devices described in paragraph: EQUIPMENT for checking the accuracy of dispensed admixtures, are operating properly.
- c. Scales Corrective Action - When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies

shall be corrected immediately.

#### 3.8.2.5 Batch-Plant Control

The measurement of all constituent materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

#### 3.8.2.6 Concrete

- a. Slump Testing - At least two slump tests shall be made in accordance with ASTM C 143 on each concrete mixture produced during each 8-hour period or less of concrete production each day. Additional tests shall be made when excessive variation in workability is reported. The result of each test for each mixture shall be plotted on a control chart on which the upper and lower limits are set as specified in paragraph: MIXTURE PROPORTIONING. The range shall be plotted on a control chart on which the upper control limit is 2 inches. Samples for slump shall be taken at the mixer, however the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, samples shall be taken at the placement site as often as required by the Contracting Officer.
- b. Slump Corrective Action - Whenever points on the control chart approach the upper or lower control limits, an adjustment shall be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount specified in the mixture proportions provided based on the free water available with the aggregates and that amount of water batched. If the adjustments to the batch weights of water and aggregates do not satisfactorily produce the required slump, the Contracting Officer may adjust the mixture proportions if the fine-aggregate moisture content is stable and within the required limits. When a single slump is outside the control limits, such adjustment is mandatory. As soon as practical after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range above the upper control limits, the slump shall be considered to be out of control, the concreting operation halted, and the additional testing for aggregate moisture content required shall be undertaken, and action taken immediately to correct the problem.
- c. Air Content - At least two tests for air content shall be made on randomly selected batches of each concrete mixture produced during

each 8 hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported. Tests shall be made in accordance with ASTM C 231. The average of each set of two tests for each mixture shall be plotted on control charts on which the average percent and upper and lower limits are set in accordance with paragraph MIXTURE PROPORTIONING for each NMSA. The range between two consecutive tests for each mixture shall be plotted on a control chart on which the upper control limit is 3.0 percent. Samples for air content shall normally be taken at the mixer, however the Contractor is responsible for delivering the concrete to the forms at the proper air content. Samples shall be taken at the placement site as often as required, depending on the Contractors delivery method, to determine any air loss.

- d. Air Content Corrective Action - Whenever points on the control chart approach the upper or lower control limits, an adjustment should be made in the amount of air-entraining admixture batched. If a single test result is outside the specification limit, immediate adjustment is mandatory. As soon as practical after each adjustment, another test shall be made to verify the correction of the adjustment. Whenever a point falls above the upper control for range, the dispenser shall be calibrated to ensure that it is operating correctly and with good reproducibility. Whenever two consecutive points either for average or range are outside the control limits, the Contracting Officer shall be notified.

#### 3.8.2.7 Inspection Before Placing

Foundation or construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify that they are ready to receive concrete. The results of each inspection shall be reported in writing.

#### 3.8.2.8 Concrete Placement

- a. Placing Inspection - The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, yardage placed, and method of placement.
- b. Placing Corrective Action - The placing foreman shall not permit placing to begin until he has verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

#### 3.8.2.9 Vibrators

- a. Vibrator Testing and Use - The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is

being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing.

- b. Vibrator Corrective Action - Any vibrator not meeting the requirements of paragraph: PREPARATION FOR PLACING shall be immediately removed from service and repaired or replaced.

#### 3.8.2.10 Curing

- a. Moist Curing Inspections - At least twice each shift, and twice per day on nonwork days an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.
- b. Moist Curing Corrective Action - When a daily inspection report lists an area of inadequate moistness, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by one (1) day.
- c. Membrane Curing Inspection - No curing compound shall be applied until the Contractor's authorized representative has verified that the compound is properly mixed and ready for spraying. At the end of each operation, he shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered and compute the rate of coverage in square feet per gallon. He shall note whether or not coverage is uniform.
- d. Membrane Curing Corrective Action - When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.
- e. Sheet Curing Inspection - At least once each shift and once per day on nonwork days, an inspection shall be made of all areas being cured using sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.
- f. Sheet Curing Corrective Action - When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by one (1) day.

#### 3.8.2.11 Cold Weather Protection and Sealed Insulation Curing

At least once each shift and once per day on nonwork days an inspection shall be made of all areas subject to cold weather protection. The protection system shall be inspected for holes, tears, unsealed joints, or other incongruities which could result in damage to the concrete. Special attention shall be taken at edges, corners, and thin sections. Any deficiencies shall be noted, corrected, and reported.

#### 3.8.2.12 Cold Weather Protection Corrective Action

When a daily inspection report lists any holes, tears, unsealed joints, or other incongruities, the deficiency shall be corrected immediately and the period of protection extended for one (1) day.

#### 3.8.2.13 Mixer Uniformity

Prior to the start of concrete placing and once every 3 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the longest time, interval uniformity of concrete mixing shall be determined in accordance with paragraph: EQUIPMENT. The initial and every fourth set of tests shall be regular tests performed on three batches of concrete. Intermediate uniformity tests shall be abbreviated tests performed on a single batch of concrete. If the mixer fails the abbreviated test, a regular test shall be immediately performed. Whenever adjustments in a mixer or increased mixing time are required because of failure of a uniformity test, the mixer shall be reevaluated by a regular test after the adjustments have been completed. If the Contractor proposes to reduce a mixing time, a regular test shall be performed to evaluate the proposed time. Additional testing shall be performed when directed when there is visible evidence of possible improper mixer performance. Results of all uniformity tests shall be reported in writing.

#### 3.8.2.14 Mixer Uniformity Corrective Action

When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

#### 3.8.3 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

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## SECTION 11290

## HYDRAULIC POWER SYSTEMS FOR REGULATING OUTLET GATES

## PART 1 GENERAL

## 1.1 GENERAL INFORMATION

The work covered by this section of the specifications consists of detailed requirements for the design, fabrication, shop assembly, testing, delivery and installation of the complete hydraulic power systems for operation of the regulating outlet slide gates as specified herein and as shown on the drawings.

## 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. Latest publications including all revisions and errata shall be applicable.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B93.5	(1979) Practice for the Use of Fire Resistant Fluids in Industrial Hydraulic Fluid Power Systems
ANSI/NFP(A)B93.11M	(1981) Hydraulic Fluid Power - Line Tubing - Seamless Low Carbon Steel
ANSI/NFP(A)B93.18M	(1973) Non-Integral Industrial Fluid Power Hydraulic Reservoirs
ANSI Y14.17	(1990) Fluid Power Diagrams
ANSI Y32.10	(1990) Graphical Symbols for Fluid Power Diagrams

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 181	(2000) Carbon Steel Forgings for General-Purpose Piping
ASTM A 182	(1995) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High- Temperature Service
ASTM A 193	(2000) 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 266	(1995) Forgings, Carbon Steel, for Pressure Vessel Components
ASTM A 312	(1995) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 354	(1995) Quenched and Tempered Alloy Steel Bolts, Studs, and Other External Threaded Fasteners
ASTM A 516	(1990; R 1996) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 536	(1999e1) Ductile Iron Castings
ASTM A 564	(1995) Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 659	(1992) Steel, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality
ASTM A 705	(1995) Age-Hardening Stainless and Heat-Resisting Steel Forgings
ASTM A 789	(1995) Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM B 505	(1995) Copper-Base Alloy Continuous Castings
ASTM D 3951	(1995) Practice for Commercial Packaging

## AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME 16	(1989) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1 - Basic Coverage
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping
ASME B36.19M	(1985) Stainless Steel Pipe

ASME B40.1 (1991) Gauges - Pressure Indicating Dial  
Type - Elastic Element

FEDERAL SPECIFICATIONS (FS)

FS FF-W-92 (1975) Washer, Flat (Plain)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (1993) Industrial Control and Systems  
Controllers, Contactors, and Overload  
Relays Rated Not More Than 2,000 Volts AC  
or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems  
Enclosures

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE ARP 598B (1986) Determination of Particulate  
Contamination in Liquids by the Particle  
Count Method

SAE J514 (1995) Hydraulic Tube Fittings

SAE J1165 (1979) Reporting Cleanliness Levels of  
Hydraulic Fluids

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

1.3.1 General

The Specification drawings indicate the general arrangement of the two hydraulic power systems for operation of the slide gates, clearances necessitated by the structure or other equipment, maximum overall dimensions, and other features. The Contractor shall be fully responsible for all design and shall furnish the detailed designs and shop drawings in conformity with these specifications, JIC H-1, and the following design criteria.

1.3.2 Design Parameters

Design Pressure 3,000 psi  
Nominal Operating Pressure 2,000 psi  
Relief Valve Setting Pressure 1,800 psi  
Pressure Switch Setting Pressure 1,700 psi  
Rated Raising or Retracting Force 900,000 lbs  
Rated Lowering or Extending Force 900,000 lbs  
Normal Operating Pressure at Cylinders 1,600 psi  
Maximum Raising or Retracting Time 30 minutes  
Maximum Lowering or Extending Time 30 minutes

Hoist Stroke 15 feet ±\*

Critical or Limiting Dimensions

Operating Temperature Range 32 - 125 F

\* Exact stroke shall be determined by manufacturer.

### 1.3.3 Allowable Stresses

The principal design parameters for the hydraulic power system are as follows:

1. Structural Items. Structural items associated with the hydraulic power system, such as support beams and clamps, shall be designed to withstand the maximum possible force exerted by the hydraulic cylinder plus any dead loads with a factor of safety of 2 based on the yield strength of the materials involved.

2. Hydraulic Cylinders. The hydraulic cylinders shall be designed to withstand the maximum possible operating pressure in the system with a factor of safety of 5 based on the ultimate strength of the material for 2 based on the yield strength of the material. A factor of safety of 3 shall be applied to the compression load when designing the hydraulic cylinders to resist buckling.

3. Stress Concentration Factors. Stress concentration factors shall be used where applicable. Reduction of allowable stresses to compensate for repeated cycles of loading is not required.

4. Earthquake. Forces due to earthquake shall be in accordance with the requirements of Section 13080 of these Specifications.

### 1.3.4 Connections

#### 1.3.4.1 Shop Connections

Shop connections shall be designed for assembly by means of welding or by bolting.

#### 1.3.4.2 Welded Connections

Design of welded connections shall be in accordance with the applicable provisions of AWS D1.1 except that provisions for repeated stress will not be required. Hydraulic cylinders shall be welded in accordance with ASME 16. Piping shall be welded in accordance with ASME B31.1.

#### 1.3.4.3 Structural Bolted Connections

Structural bolted connections carrying primary loads shall be made with ASTM A 325 bolts.

### 1.3.5 System Operation

The six regulating outlet (RO) gates will be operated using hydraulic operators. One gate at a time or 3 gates at a time may be operated as needed. The operators will be equipped with proportional control valves to provide position control. The gates will be operated one at a time for the

first 6 inches of travel. Above 6 inches of opening, 1 or 3 gates will be operated at a time. A selector switch will be used to select single or multiple gate operations. Gate control will be from both the Local Control Cabinet (LCC) in the gate chamber and the Emergency Motor Control Center (EMCC) in the control room at El. 596. A selector switch on the local control cabinet will be used to select local control or remote control (from the control room). The gate positions will be transmitted to the control room using a 4 - 20 ma transmitter. The gate position will be determined by measuring the gate stem travel. The gate position will be displayed using a digital panel meter (DPM) located on the gate control panel. The gate position indication will be used to adjust the gates for a maximum of 1-inch difference in opening. The proportional control valves should move all three gates to the same opening. The 1-inch difference can be adjusted by controlling the speed of operation of each gate.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

###### Shop Drawings; G

Detailed shop drawings shall include fabrication, shop assembly, delivery, and field installation drawings. Any component part of fabricated items whether explicitly shown or omitted on the specification drawings shall be detailed on the shop drawings. If departures from the specification drawings are deemed necessary by the contractor, details of such departures, including changes in related portions of the project, and reasons therefore, shall be submitted with the shop drawings.

1. Fabrication drawings shall be provided for all mechanical and structural parts or components except those which are of standard manufacture. The drawings shall show complete details of materials, tolerances, machined surface finishes, connections, and proposed welding sequences which differentiate shop welds and field welds.

2. Shop assembly drawings shall provide details for connecting the adjoining fabricated components in the shop to ensure satisfactory field installation.

###### Hydraulic Schematic; G

A complete hydraulic schematic, in accordance with ANSI Y32.10 and ANSI Y14.17, shall be provided. All hydraulic components shall be shown on the schematic, and all setpoint and size parameters shall be indicated for each component.

###### Delivery Drawings; G

Delivery drawings shall provide descriptions of methods of delivering components to the site, including details for supporting fabricated components during shipping to prevent

distortion or other damage.

Field Installation Drawings; G

Field installation drawings shall provide a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment, the provisions to be taken to protect concrete and other work during installation, the method of maintaining components in correct alignment, and the methods for installing other appurtenant items.

#### SD-03 Product Data

Manufacturer's Catalog Data; G

Manufacturer's catalog data and descriptive literature shall be submitted for standard equipment and products to be incorporated in the work, including all materials and equipment specified in Paragraphs: MATERIALS AND MECHANICAL EQUIPMENT and ELECTRICAL EQUIPMENT. These data shall include specifications and assembly drawings showing sizes, ratings, parts and material lists, overall dimensions and mounting dimensions. Detailed piping and valve layouts, pipe connections to all valves, hydraulic control unit and hydraulic cylinders shall be shown.

Design computations shall be submitted for all items of equipment by the Contractor.

#### SD-06 Test Reports

Operational Test Reports

Operational test reports shall be submitted for all required shop testing and testing of the equipment after installation. Contractor's quality control reports shall be submitted in conformance with the requirements of FAR 52.246-2, INSPECTION AND ACCEPTANCE.

#### SD-08 Manufacturer's Instructions

Shop Assembly and Testing; G

Procedures for shop testing shall be submitted for all testing outlined in Paragraph: SHOP ASSEMBLY AND TESTING.

Cleaning and Flushing; G

Procedures for field cleaning and flushing shall be submitted as outlined in Paragraph: CLEANING AND FLUSHING THE SYSTEM. The Contractor shall submit a detailed field cleaning procedure not less than 10 days before start of cleaning operations.

Field Testing; G

Procedures for field testing shall be submitted as specified in Paragraph: FIELD TESTING. The Contractor shall submit his proposed testing program to the Contracting Officer at least 4 weeks prior to the first scheduled test to ensure agreement as to

personnel required and scope of the testing program.

#### SD-10 Operation and Maintenance Data

Operation and Maintenance Manual; G

The operation and maintenance (O&M) manual shall contain all information which may be needed or used for operation, maintenance, repair, dismantling or assembling, and for identification of parts for ordering replacements. The manual will be subject to approval by the Contracting Officer. The Contractor shall furnish five complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment to the Contracting Officer. Each set shall be permanently bound and shall have a hard cover. One complete set shall be furnished prior to field testing and the remaining sets shall be furnished before the contract is completed. The following identification shall be inscribed on the covers: "OPERATING AND MAINTENANCE INSTRUCTIONS", title of the project, location of the project, the name of the Contractor, and the contract number. A flysheet shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. The instructions shall include, but not be limited to, the following:

1. A cross-section drawing of the hydraulic cylinder with parts list.
2. A system layout drawing showing the piping, valves, and controls.
3. A system hydraulic schematic.
4. Electrical wiring and control diagrams.
5. Operating and maintenance instructions.
6. Manufacturer's bulletins, catalog cuts, and descriptive data.
7. Parts lists and recommended spare parts.

#### 1.5 QUALITY ASSURANCE

The Contractor shall ensure that required tests, workmanship, and other performance aspects of the work comply with the applicable quality assurance requirements specified herein. In accordance with FAR 52.246-2, INSPECTION AND ACCEPTANCE, the Contractor shall provide continuous inspection of all operations for quality control and record the results for submitting to the Contracting Officer to show compliance with the contract requirements.

#### 1.6 DELIVERY, STORAGE AND HANDLING

##### 1.6.1 Packaging

The hydraulic power systems shall not be prepared for shipment until they have been inspected and accepted for shipment at origin by the Contracting Officer or his authorized representative, unless inspection has been waived

in writing. Each hydraulic power system or subassembly shall be shipped completely assembled. The subassemblies shall be defined as the following:

1. Hydraulic cylinders.
2. Hydraulic power units.
3. Piping assemblies.
4. Local control consoles.
5. Remote control consoles.

The subassemblies shall be provided with adequate protective pads, supports, and blocking and shall be securely restrained to prevent distortion or damage to the painted surfaces in transit. Any loss or damage during shipment, including damage to the painted surfaces, will be considered the responsibility of the Contractor, and shall be replaced or repaired without cost to the Government. All accessories and spare parts shall be packed separately in containers plainly marked "ACCESSORIES ONLY" or "SPARE PARTS ONLY". A packing list listing the contents of each container shall be placed in a moisture-proof envelope and securely fastened to the outside of the container. Standard commercial packaging in accordance with ASTM D 3951 will be acceptable except where a different method or standard of packaging is specifically called for herein.

#### 1.6.2 Shipping, Preservation and Storage

Packing, crating, cradles, etc., necessary to ensure safe shipment re the responsibility of the Contractor and shall become the property of the Government upon delivery of the equipment. The hydraulic cylinders shall be filled with the specified hydraulic fluid and the piping connections sealed. The shipping provisions shall be such that the cylinders may be rotated in increments of 90 degrees during storage. Should the cylinders be stored by the Contractor during fabrication, shipping, or at the worksite in the horizontal position more than 30 days, they shall be rotated every 30 days as follows: first 90 degrees, then 180 degrees, then 90 degrees, and then 180 degrees. Internal rod supports shall be provided to prevent the rod from deflecting and damaging the rod and cylinder bore during handling and shipping. Machined surfaces shall be adequately protected from corrosion and physical damage. Equipment delivered and placed in storage shall be stored with protection from the weather, humidity, temperature variation, dirt and dust, or other contaminants.

#### 1.7 PROJECT/SITE CONDITIONS

The Contractor shall visit the site to become thoroughly familiarized with all details of the work and working conditions, to verify dimensions in the field, and he shall then advise the Contracting Officer of any discrepancies prior to performing any work. The contractor shall be specifically responsible for the coordination and proper relation of his work to the structure and work of all trades.

#### 1.8 WARRANTY

All equipment shall be guaranteed for a period of 2 years from the date of acceptance. Replacement parts shall be guaranteed for 2 years from date of replacement. Warranty shall be against defective materials, design and workmanship. In cases where the equipment manufacturer's advertised

minimum guarantee is in excess of 2 years, it shall remain in force for its full period. Upon receipt of notice from the Government of failure of any of the parts during the warranty period, new replacement parts shall be furnished and installed promptly at no additional cost to the Government.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND MECHANICAL EQUIPMENT

#### 2.1.1 General

Materials and mechanical equipment shall conform to the requirements indicated on the drawings or referred to herein, and when not covered thereby, materials and mechanical equipment of the best commercial grade quality suited to the intended use and as approved by the Contracting Officer shall be furnished. The manufacturer's name, address, and catalog number shall be permanently displayed on a nameplate securely attached to each major item of equipment.

#### 2.1.2 Standard Products

Where items are referred to hereinafter as "similar and equal to" a particular manufacturer's product, such references have been made merely as a convenient method of indicating the type of material or equipment required, with no intention of asserting superiority thereof. The standard product of any reputable manufacturer regularly engaged in the commercial production of the type and quality of material or equipment referred to will not be excluded on the basis of minor differences, provided essential requirements of the specifications relative to materials, capacity, and performance are met. The Contractor shall, in accordance with Paragraph: SUBMITTALS, furnish for approval, performance capacities and other pertinent information concerning the manufacturer's "equal to" standard products which he intends to incorporate in the work. "Equal to" standard products installed or used without such approval shall be at the risk of subsequent rejection. Such components as described below but not shown on the drawings or hydraulic schematic may be used with prior approval of the Contracting Officer but shall conform to the following specifications.

#### 2.1.3 Hydraulic Cylinders

##### 2.1.3.1 General

The outside of the finished cylinder shall be turned concentric with the bore and the interior shall be honed to the dimensions, tolerances, and finish shown on the shop drawings. The finished wall thickness shall not be less than that shown on the approved shop drawings. Flanges shall be welded to the cylinder parallel with each other and perpendicular to the cylinder centerline. Tolerances shall be as shown on the drawings. After completion of all welding, the cylinder shall be stress relief heat treated. All welds shall be radiographed including those on the end mounts. The assembled cylinder shall be of such straightness that the piston and rod move smoothly therein without any indication of binding or tight spots. Surface finishes shall be as indicated on the drawings. The cylinder material shall be steel conforming to one of the following options:

- a. Option A: Rolled steel plate conforming to the requirements of ASTM A 516, Grade 70, and welded flanges conforming to ASTM A 181, Class 70.
- b. Option B: The shell shall be centrifugal cast steel conforming to the

requirements of ASTM A 216, Grade WCC, and welded flanges conforming to ASTM A 181, Class 70, or cast from ASTM A 216, Grade WWC steel.

c. Option C: The shell and flanges shall be a solid trepanned forging conforming to the requirements of ASTM A 266, Class 1.

#### 2.1.3.2 Piston Rods

The piston rod shall be fabricated from stainless steel conforming to ASTM A 564 or 705, Type 630 or XM-12. The piston rod shall be heat treated to a condition of H-1150 before final machining. If the piston rod is composed of two or more pieces, the welds shall be radiographed. The piston rod shall have a ceramic coating with a minimum thickness of 0.008 inch, a surface finish of 12-14 microinches rms, surface hardness of 67 Rc minimum, impact resistance of 5-11 lb-ft, modulus of elasticity of  $52 \times 10^6$  -  $60 \times 10^6$  psi, linear expansion coefficient of  $4.0 \times 10^{-6}$  degrees F, and be capable of withstanding a fracture force of 41 ksi minimum. Gate stem sections which do not retract into the cylinder shall be of the same material as above except that ceramic coating is not required and the final finish shall have a roughness of not more than 32 microinches rms.

#### 2.1.3.3 Pistons

The piston shall be cast iron conforming to ASTM A 536, Grade 80-55-06 or 10-50-05.

#### 2.1.3.4 Piston Wear Rings

The piston ring shall be a one-piece bronze type, suitable for soil hydraulic service at 2,000-pounds-per-square-inch pressure. The piston ring joint shall be an angled or overlapped step-cut type which will minimize the areas of leakage through the joint and provide an effective seal for hydraulic service.

#### 2.1.3.5 O-Ring Seals

The O-ring seals shall be as recommended by the manufacturer and designed for 3,000 psi service.

#### 2.1.3.6 Stem Wiper-Scraper

The stem wiper-scraper shall have one or two flexible corrosion-resisting, metal-spring scraper rings mounted with a synthetic rubber ring. The scraper shall have a snug fit on the stem and shall have sufficient play to permit alignment under normal working clearances. It shall be capable of removing materials stuck or frozen to the stem. The wiper-scraper shall be securely mounted in the bushings as shown on the drawings and shall be equal to Hercules Products Division of Richardson Company, 11063 Walden Road, Alden, New York 14004.

#### 2.1.3.7 Piston and Piston Rod Seals

Piston and piston rod seals shall be of the low leakage V-ring, nonadjustable gland type, designed for 3,000 psi service.

#### 2.1.3.8 Rod Seal Gland and Locking Device Flange

The rod seal gland and locking device flange shall be fabricated from bronze conforming to ASTM B 505, Alloy No. C95400 or C93200.

#### 2.1.3.9 Hoist Locking Device

The hoist locking device shall be fabricated from stainless steel conforming to ASTM A 564 or ASTM A 705, Type 630 or XM-12, condition H-1150.

#### 2.1.3.10 Hydraulic Packings

The piston and piston stem shall be provided with hydraulic packings to prevent oil leakage when the hydraulic cylinder is subjected to a pressure up to 2,000 pounds per square inch during gate opening and closing. **No leakage of oil across the piston seals shall be acceptable in the shop test. The cylinder manufacturer shall provide seals to satisfy this requirement in the shop as well as during the field test after installation and warranty the effective sealing for a period of five years after implementation..** The hydraulic packings shall be suitable for use with hydraulic oil and shall be equal to Garlock, Inc., Palmyra, New York, Style 432. The piston packing shall be equal to Polypack, as manufactured by Parker Packing Company, P.O. Box 1505, Salt Lake City, Utah.

#### 2.1.4 Hydraulic Power Unit

The hydraulic power unit shall be a self-contained, packaged unit with all piping, valving and electrical components designed by the Contractor to operate the hydraulic cylinders in accordance with the criteria stated in Paragraph: DESIGN PARAMETERS. The power unit shall be designed to meet the space limitations shown on the drawings and shall be configured essentially as shown. The hydraulic power unit shall have the following features:

1. The system shall be capable of operating one gate at a time or three gates at a time as needed.
2. Each hydraulic system shall operate at 2,000 psig, with a design pressure of 3,000 psig. The test and maximum pressure for the system shall be 3,000 psig.
3. Each hydraulic pump shall be rated for 25 gpm at 2,000 psig.
4. The capacity of the system with one pump running shall provide a gate lift speed of approximately 1 foot per minute (fpm) for one gate with a pump speed not to exceed 1,800 rpm.
5. The system shall be designed so that one pump and motor can be removed while the other pump is operating or both pumps can be run simultaneously.
6. The oil reservoir shall be sized to contain the volume of oil required to store all of the oil used when closing three gates. The reservoir is to have a minimum capacity of 500 gallons, and shall be appropriately sized by the Contractor.
7. Pumps, motors, and pressure relief valves shall be mounted directly to the respective reservoir.
8. The oil storage reservoir shall include suction line indicating filters, return line filters, air vent and level site gage.
9. Piping and fittings shall be stainless steel with a design pressure of 3,000 psig.

10. Solenoid controlled proportional directional control valves shall throttle flow in proportion to raise or lower commands.
11. A hydraulic pressure switch shall disconnect the pump motor circuit when the gate leaf hits the bottom seal or the bonnet cover.
12. The RO slide gates shall have 2 sets of fully-open and fully-closed limit switches.
13. The hydraulic power unit shall have local hand operated four-way valve for gate raise/lower control.
14. All exposed steel shall be coated to protect against corrosion.
15. Provide all equipment to mechanically operate the stem position transmitting device described in Section 16051.

#### 2.1.5 Oil Reservoirs

##### 2.1.5.1 General

The oil reservoir shall be dimensioned by the Contractor to meet the space limitations on the platform at El. 512.0 shown on the specification drawings. The reservoir shall be made of steel with welded joints and shall conform to the requirements of ANSI/NFP(A)B93.18M and as shown on the shop drawings. The reservoir shall be equipped with a fluid level indicator and filler with built-in strainer. There shall be a baffle provided between the intake and return lines to facilitate the separation of air and foreign matter from the hydraulic fluid. Both the intake and return pipes shall be brought down to a distance of 1-1/2 pipe diameters above the tank bottom. Interior surfaces of the reservoir shall be cleaned down to bright metal and coated with any epoxy-based urethane finish or an approved alternate that is compatible with oil and water.

##### 2.1.5.2 Reservoir Heater

The reservoir shall be provided with one or more screw plug type immersion heaters with a watt density not to exceed 11 watts per square inch and a built-in thermostat set to maintain the hydraulic oil at 60 degrees F. The heater sheath and screwplug shall be fabricated from stainless steel. Total heating output shall be calculated by the manufacturer. The heater shall be supplied with a watertight, stainless steel, NEMA 4X terminal housing as a minimum.

##### 2.1.5.3 Magnetic Separators

The manufacturer's standard magnetic separator shall be provided in the reservoir. The magnetic separator shall consist of a high-strength permanent magnet arranged for rigid mounting with the poles of the magnet exposed to the fluid in the reservoir. The magnet shall be mounted on a removable rod assembly installed through the top of the reservoir.

##### 2.1.5.4 Air Breather

The reservoir shall be provided with an air breather which removes dirt and moisture from the incoming air. The incoming air shall first pass through a desiccant bed to remove the moisture, and then pass through a filter to eliminate the solid contaminants before entering the reservoir. Outgoing

air shall pass directly to the atmosphere through a check valve. The breather shall also provide visual indication of the desiccant and filter condition. The breather shall conform to applicable provisions of Joint Industry Conference (JIC) Standards for Industrial Equipment.

#### 2.1.6 Pumps

The pumps for the hydraulic system shall be electric motor-driven, fixed displacement, piston type rated to deliver a nominal 52 gpm at 2,000 psi while operating with the specified oil in the specified temperature range. The pump delivery capacity and pressure shall be finalized based upon Contractor's design and approved shop drawings. Maximum rotating speed shall be 1,800 rpm. Exposed rotating parts shall be properly safety guarded. The pumps shall mount on the reservoir in a manner similar to that shown on the shop drawings so that the pump suction is flooded. The pumps shall operate on 480 volts, 60 Hz, three-phase power. The pumps shall be rated for continuous operation at a discharge pressure equal to or greater than the system design pressure. The rated discharge capacity of each pump shall not be less than required by approved shop drawings when the pump is operated at the design input speed and discharge pressure. The pumps shall conform to Joint Industry Conference (JIC) Standards for Hydraulic Equipment.

#### 2.1.7 Filters

The filters shall be located in the return line to the reservoir and in the pump discharge line and shall be of the duplex type with a differential pressure device to indicate the need for filter element service. The filter element shall have a rating of 10 microns absolute unless a smaller mesh is recommended by the pump manufacturer. The filter shall be rated for use with hydraulic oil and the pressure drop should not exceed 6 psi in the clean condition. The return filter shall be pressure rated for 200 psi and a flow rate required for satisfactory operation of system. The discharge line filters shall be pressure rated for 2,000 psi and a flow rate required for satisfactory operation of system. The filters shall conform to applicable provisions of ASME HPS-1994 High Pressure Systems.

#### 2.1.8 Gauges

##### 2.1.8.1 Pressure Gauges

Pressure gauges shall conform to ASME B40.1, have a black enameled metal case, a 4-1/2-inch dial, and a stainless steel Bourdon tube. The scale range of the gauge shall be approximately 150 percent of the maximum pressure of the line in which installed. Gauges shall be the safety type with solid fronts and blowout backs. Each gauge shall be provided with a pressure snubber. Gauge mounting shall be as indicated on the approved shop drawings.

##### 2.1.8.2 Thermometer

A direct indicating thermometer shall be provided to indicate fluid temperature in the reservoir. The thermometer shall be of the bimetallic type mounted directly on the reservoir. The thermometer shall have a minimum 3-inch dial with black markings on a white background. The scale range shall be 20 to 240 degrees F. The case and stem shall be corrosion resistant and the wetted components shall be stainless steel. Thermometer wells of the separable socket type shall be provided for each thermometer with a direct type bulb. The thermometer shall conform to ASME PTC 19.3,

Temperature Measurement.

#### 2.1.9 Valves

##### 2.1.9.1 General

Valves shall have a minimum pressure rating of 3,000 psi unless stated otherwise. Valves 1 inch or larger shall have socket-welded piping connections. Valves less than 1 inch shall have SAE straight thread ends and O-rings with tube fittings. Valves shall be specifically designed and rated for hydraulic system applications.

##### 2.1.9.2 Ball Valves

Ball valves shall be made of stainless steel and designed for use with hydraulic oil. Pipe connections shall be socket welded. The valves shall have replaceable seats and be repairable without disturbing the welded connections.

##### 2.1.9.3 Flow Control Valves

The hydraulic operators shall be equipped with flow control valves to allow throttling the oil flow in proportion to raise-lower commands. The Contractor shall furnish all required flow control valves to provide a hydraulic control system to operate the RO gates in accordance with the Specifications. A typical hydraulic control schematic is shown in the specification drawings. All hydraulic control valves furnished shall meet the following minimum requirements.

- a. Four-Way Valve - Four-way valves shall be lever operated, three position detent, with a minimum flow capacity as required for specified gate operation. Working pressure shall be compatible to the overall hydraulic system pressure for satisfactory gate operation. The valves shall operate so that pressure may be directed to either of two ports by shifting the lever. The center position shall block all ports.
- b. Solenoid-Operated, Two-Way Valve - Solenoid-operated, two-way valves shall be single solenoid operated. The valve shall have a minimum flow capacity as required for specified gate operation. Working pressure shall be compatible to overall hydraulic system pressure for satisfactory gate operation.
- c. Proportional Directional Control Valves - Proportional direction valves shall be solenoid operated, two stage, with feedback transducers. The valves shall be furnished with compatible power amplifier to operate the solenoid. The throttling of the valve shall be controlled using multiturn potentiometers. Single potentiometers or dual potentiometer shall be used to control throttling in both raise and lower directions. The power amplifiers shall operate from 120 volts A.C. power.

The valve flow capacity and operating pressure shall be selected as required for specified gate operation. Valve electronic controls shall be selected to allow three RO gates to be operated and the gate opening or closing shall not vary more than 1 inch between all three gates.

##### 2.1.9.4 Pressure Relief Valves

Pressure relief valves shall be adjustable with a body designed for a set pressure of 2,200 psi. The valve shall have the capacity required for

satisfactory gate operation. The normal setting pressure will be at about 1,800 psi.

#### 2.1.9.5 Supply Spring Loaded Check Valves

Supply spring loaded check valves shall be of stainless steel construction and shall be the ball or poppet type with a body designed for high shock and 3,000 psi service.

#### 2.1.9.6 Return Spring Loaded Check Valves

Return spring loaded check valves shall be of stainless steel construction and shall be the ball or poppet type with a body designed for 3,000 psi service. Cracking pressure shall be 75 psi.

#### 2.1.9.7 Bleeder Valves

Bleeder valves shall be 1/4 inch, stainless steel construction and wrench operated.

#### 2.1.9.8 Pressure Snubbers

Pressure snubbers shall be provided for all pressure gauges and pressure switches to protect against shock and provide more stable instrument operation. Snubbers shall be of stainless steel construction.

#### 2.1.9.9 Counterbalance Valve

A counterbalance valve, if used, shall be installed in the oil line to the bottom side of the hoist piston as indicated on the shop drawings to balance the load being held by the cylinder. The valve shall be directly operated, have an external type drain, and shall be adjustable for operating over a pressure range of 1,000 psi to 2,500 psi. The valve shall be designed for a system operating pressure of 2,000 psi. The valve shall permit unrestrained flow to the underside of the hoist piston and shall function to retain pressure of 1,600 psi in the hoist cylinder.

#### 2.1.9.10 Flow Switches

The Contractor shall furnish and install a flow switch in-line ahead of the check valve in each oil pump main supply line. This switch shall be as shown on the shop drawings approved by the Contracting Officer. The flow switch shall be suitable for flow rates of 0-40 gallons per minute. The flow switch shall be set for 20 gallons per minute. The flow switch shall have a minimum working pressure compatible to the overall hydraulic system pressure. The flow switch shall have a minimum of two Form C contacts rated 5 amps at 125/250 volts A.C.

#### 2.1.10 Piping

##### 2.1.10.1 General

Piping, tubing and hose shall be designed for a working pressure of 3,000 psi. Pipe shall be used when a 1 inch or larger diameter is required. External cylinder piping shall be as shown on the shop drawings. Pipe shall be welded or threaded as required on the approved shop drawings.

##### 2.1.10.2 Pipe

Pipe shall be seamless stainless steel conforming to ASME B36.19M and ASTM A 312, Grade TP304. The piping weight class shall be Schedule 80s. The pipe shall conform to the cleanliness requirements of ANSI/NFP(A)B93.11M.

#### 2.1.10.3 Pipe Fittings

Pipe fittings shall be the socket welding type conforming to ASME B16.11 and made of stainless steel conforming to and ASTM A 182, Grade F304. The pressure class shall be 3,000 pounds. Flanges shall conform to ASTM A 182 with the grade suitable for the pipe to which attached. Threaded fittings shall also conform to the above, but shall be used only where absolutely necessary for the application.

#### 2.1.10.4 Unions

Unions shall be the O-ring type made of stainless steel with socket-welding ends. The Contractor may, at his option, substitute four bolt split flanges with O-rings for the unions.

#### 2.1.10.5 Hydraulic Tubing

Tubing shall be seamless stainless steel tubing conforming to ASTM A 789. The wall thickness shall be selected to provide a safety factor of 6 based on the manufacturer's ratings for burst strength.

#### 2.1.10.6 Tube Fittings

Tube fittings shall be made of stainless steel and be the flareless type with SAE straight threads and O-ring seals. The fittings shall conform with SAE J514.

#### 2.1.10.7 Hose

Flexible hydraulic lines, if permitted by the Contracting Officer, shall be wire-reinforced, high-pressure type hose made of neoprene or Buna N. Flexible hose shall be rated by the manufacturer for a working pressure not lower than the system operating pressure indicated above with a factor of safety of 4. Fittings shall be specifically designed for use with the hose selected and shall be as recommended by the hose manufacturer. Fittings shall be made of stainless steel and shall be the reusable type.

#### 2.1.11 Bolts, Nuts and Washers

##### 2.1.11.1 Carbon Steel Bolts and Nuts

Carbon steel bolts and nuts shall conform to ASTM A 354, Grade BC, with ASTM A 194, Grade 2H nuts. Structural bolted connections carrying primary loads shall be made with ASTM A 325 bolts.

##### 2.1.11.2 Stainless Steel Bolts and Nuts

Stainless steel bolts and nuts shall conform to ASTM A 193, Grade B7 or B16, with ASTM A 194, Grade 8 nuts.

##### 2.1.11.3 Flat Washers

Flat washers shall conform to FS FF-W-92, Type A, Grade I, Class A or B.

#### 2.1.12 Hydraulic Fluid

The hydraulic fluid to be used during shop testing to fill the cylinders before shipment, flush the system after installation, and to fill the complete hydraulic system shall be an all-weather type hydraulic oil which has a high viscosity index, low pour point, rust and oxidation inhibitors, and antifoam properties. The oil shall also be formulated to separate quickly from water to prevent formation of emulsions. The hydraulic fluid shall be certified by the manufacturer as fire resistant in conformance with ANSI B93.5. Fresh hydraulic fluid shall be filtered through a 10 micron filter before it is added to the system. All oil shall be supplied by the Contractor and two 55 gallon containers shall be furnished to the Contracting Officer for a reserve supply.

## 2.2 ELECTRICAL EQUIPMENT

### 2.2.1 General

The electrical equipment for the hydraulic power systems shall comply with the specification drawings and the specifications herein. Other electrical materials and equipment required for the installation of the hydraulic power systems shall be as specified in SECTION 16415: ELECTRICAL WORK, INTERIOR. All electrical equipment furnished shall be standard catalog items under regular manufacture with pre-existing catalog ratings equal to or better than the requirements of the specification drawings and specifications. The Contractor's request for approval of equipment other than as specified herein or as shown on the specification drawings shall be accompanied by technical and descriptive data and specifications sufficient for the Contracting Officer to determine its adequacy. Unless otherwise specified herein or indicated on the specification drawings, all electrical materials and equipment shall meet the standards, specifications, and tests referred to herein.

### 2.2.2 Standard Products

Where its are referred to hereinafter as "similar and equal to" a particular manufacturer's product, such references have been made merely as a convenient method of indicating the type of material or equipment required, with no intention of asserting superiority thereof. The standard product of any reputable manufacturer regularly engaged in the commercial production of the type and quality of material or equipment referred to will not be excluded on the basis of minor differences, provided essential requirements of the specifications relative to materials, capacity, and performance are met. The Contractor shall, in accordance with Paragraph: SUBMITTALS, furnish for approval performance capacities and other pertinent information concerning the manufacturer's "equal to" standard products which he intends to incorporate in the work. "Equal to" standard products installed or used without such approval shall be at the risk of subsequent rejection.

### 2.2.3 Pump Motors

#### 2.2.3.1 General

The pump motors shall conform to the applicable requirements of NEMA MG1, except as hereinafter specified, and shall be designed to withstand full voltage starting. The motor shall be of totally enclosed frame construction and shall be air cooled. A stainless steel drain-breather similar and equal to Crouse-Hinds type "ECD Universal" shall be provided and located so that any water present can be drained from inside the motor.

The motors shall have encapsulated windings. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for the motors specified. Manual or automatic control and protective or signal devices required for the operation, and any control wiring required for controls and devices but not shown on the electrical drawings, shall be provided.

#### 2.2.3.2 Rating

The motors shall operate on 480 volts, 60 Hz, 3 phase power and shall be sized to operate the pumps specified in Paragraph: PUMPS. The motor shall be designed to operate continuously without exceeding the temperature rise permitted by the applicable NEMA standards for the class of insulation and frame construction used.

#### 2.2.4 Control Components

##### 2.2.4.1 Control Devices and Wiring

Manual or automatic control protective or signal devices required for the specified operation and all control wiring for these controls and devices shall be provided whether or not indicated on the specification drawings. Electrical control devices shall have minimum current and voltage ratings in accordance with the requirements of NEMA ICS 2 contact rating designation A 300, as applicable, unless larger ratings are indicated on the drawings or are required. Control devices shall be provided with the number and arrangement of contacts required to perform the specified control functions. Devices shall be provided with or installed in NEMA 4X enclosures.

##### 2.2.4.2 Pressure Switches

Pressure switches shall have a minimum pressure rating of 1,000 psi and maximum of 2,000 psi with set point operating as shown on the shop drawings approved by the Contracting Officer. The switches shall be enclosed in watertight, galvanized steel, NEMA 4X housings. The switches shall be provided with a normally open, normally contact having a minimum rating of 5 amps, 125/250 volts A.C. The setting pressure shall be at about 1,700 psi.

#### 2.2.5 Control Consoles and Valve and Gauge Panels

##### 2.2.5.1 Control Console Construction

The control console shall include a basic frame with metal panels fully custom fabricated or it may consist of custom modules using standardized components where available to meet the dimensional and functional characteristics shown on the specification drawings and specified herein. The console shall be constructed of steel meeting the requirements of NEMA ICS 6. Steel sheet shall conform to ASTM A 659. Removable nuts and hardened sheet metal screws. Screws and nuts shall be stainless steel. Access panels shall be secured with spring-loaded, quarter-turn, fasteners with studs held captive in the removable panel. The console shall be equipped with adequate louvered panels to ventilate the interior and dissipate the heat generated within the console. Special equipment supports and guides shall be provided as required to support the equipment and other components within the console. The interior and exterior surfaces shall be finished with one coat of primer and two coats of the manufacturer's standard baked-on white enamel finish.

#### 2.2.5.2 Valve and Gauge Panel Construction

Valve and gauge panels shall be constructed of steel plate thick enough to provide rigid support for the valves and other components mounted thereon. All piping shall be terminated with bulkhead type connections in a position convenient for the connection of external lines. Primer and finish shall be the manufacturer's standard coating.

#### 2.2.5.3 Nameplates and Instruction Plates

Nameplates shall be provided for each device on the control console, valve panels, and gauge panels. Nameplates shall clearly indicate the function of each device and, in the case of manually operated controls, shall indicate the condition established for each position of the control. Instruction plates shall clearly indicate the proper procedures and sequences of operations to activate the system, to operate the system, and to secure the system after completion of operation. Lettering on nameplates shall be machine engraved on plastic laminate with white characters on a black background. Instruction plates shall be mounted on a rigid backing and covered with clear, rigid plastic sheeting. Instruction plates shall be mounted in a location easily visible to an operator stationed at the console or panel.

### 2.3 SHOP ASSEMBLY AND TESTING

#### 2.3.1 General

Each hydraulic power system shall be completely shop assembled and tested using temporary piping and wiring, as approved by the Contracting Officer, to determine the correctness of fabrication and the matching of component parts to ensure acceptable operation after field erection. Shop tests shall be made in the presence of the Contracting Officer, unless otherwise authorized in writing. Upon satisfactory completion of the tests, preliminary acceptance will be made by the Contracting Officer.

#### 2.3.2 Cleaning

Extreme care shall be taken during shop assembly to avoid inclusion of foreign materials into the equipment. The interior of the piping shall be cleaned with lint free cloths and flushed with oil at a minimum velocity of 15 fps which has passed through a 10 micron filter. The cleaning procedure shall clean the system of particles so that the contamination level is below 17/14 in accordance with SAE J1165. The manufacturer shall take three 500-milliliter samples at random locations according to ANSI B93.19. Particle counting on each sample shall be performed in accordance with SAE ARP 598B by an approved independent test laboratory. Water content of each sample shall be below 200 ppm. If any sample does not comply with the permissible contamination limits, the system shall be recleaned and reinspected. The piping and valves shall be sealed with enough oil in the system to protect the metal surfaces.

#### 2.3.3 Cylinder Tests

Each cylinder shall be filled with the specified hydraulic fluid filtered to 10 microns, taking care to exclude all air. Each cylinder shall then be hydrostatically tested at 2,500 psi for a minimum of 4 hours. With the rod and piston fully retracted, and the pressure applied to the lower side of the piston, the upper end shall be observed for leakage past the piston.

Any leakage past the seals shall be cause for rejection. The cylinder rod and piston shall then be extended and observed for smooth, even travel. Any operational problems or source of leakage to the outside of the cylinder will be cause for rejection. The Contractor shall submit specifications for the hydraulic fluid recommended by the cylinder manufacturer for the approval of the Contracting Officer.

#### 2.3.4 Hydraulic Power Units

Shop fabricated power and control units and piping shall be hydrostatically tested at the maximum pressure allowed by the installed equipment. Valves and operators shall undergo a functional test and the pumps shall be tested to verify flow and pressure ratings. The power unit shall then be connected to the hydraulic cylinder and operationally tested at 2,000 psi. Any operational problems will be cause for rejection.

#### 2.4 SPECIAL TOOLS

One set of special tools required for assembly or disassembly of any of the equipment being supplied shall be furnished on an approved tool board. A list of all such tools shall be included in the **shop drawing submittal**.

#### 2.5 SPARE PARTS

A set of spare parts as recommended by the manufacturers shall be supplied.

All spare parts shall be duplicates of the original parts they are intended to replace. Each spare part shall bear a tag or label securely attached clearly identifying the component for which it is intended. Spare parts shall include as a minimum:

1. One spare set motor and pumps for control unit.
2. One spare motor starter for each hoist control unit.
3. One spare switch of each type.
4. One set of packings for each hydraulic cylinders and piston.
5. One set of hydraulic control valves.
6. One power amplifier suitable for control valves furnished.

A complete list of spare parts shall be submitted with the **shop drawing submittal**.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 General

The Contractor shall install the equipment specified and as shown on the shop drawings approved by the Contracting Officer to complete the hydraulic power systems for operation of the slide gates. Installation of hydraulic components shall be in accordance with the manufacturer's written instructions and under the direction of the erection engineer or manufacturer's representative. Complete units or assemblies shall be installed without disassembly. Necessary supports for all appurtenances, pumps, motors, and other equipment or components shall be provided as shown

on the shop drawings. Floor-mounted equipment shall be anchored to concrete pads by anchor bolts or expansion anchors as shown on the drawings. Installation shall be in accordance with SECTION 05501: METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS and SECTION 16415: ELECTRICAL WORK, INTERIOR.

### 3.1.2 Cleaning and Flushing the System

Extreme care shall be taken during assembly to avoid the entrance of abrasives, dirt, metal chips, and other foreign materials into the hydraulic system through open ends of piping, tubing, and ports of the components. The Contractor shall submit a detailed cleaning and flushing procedure for approval in accordance with Paragraph: SUBMITTALS. The procedure shall include a detailed description of the equipment, materials, formulations of cleaning agents, solution temperatures, duration of each phase of the cleaning operation, method of removal of cleaning agents, and method of drying after cleaning. The procedure shall clean the system of particles so that the contamination level is below 17/14 in accordance with SAE J1165. The Contractor shall take three 500-milliliter samples at approved locations according to ANSI B93.19. Particle counting on each sample shall be performed in accordance with SAE ARP 598B by an approved independent test laboratory. Water content of each sample shall be below 200 ppm. If any sample does not comply with the permissible contamination limits, the system shall be recleaned and reinspected. When flushing is completed, the system shall be drained and then filled with the specified hydraulic fluid.

### 3.1.3 Filling and Bleeding the System

Oil used to fill the system shall be filtered through a 10-micron filter. The complete hydraulic power system shall be bled to remove all air from the system. Care shall be taken to exclude as much air as possible during initial filling. The hydraulic cylinders shall be filled in the horizontal position with the piping connections up to allow air to escape, and the piping shall be filled in a manner that excludes as much air as possible. The system, once filled, shall be bled of air, operated, and periodically bled during the first week of operation to remove any air that might have been entrained in the system.

## 3.2 PAINTING

All exposed exterior surfaces of assemblies and equipment, except stainless steel, synthetic rubber, and plastic, shall be shop primed and coated as specified in SECTION 09940: PAINTING: HYDRAULIC STRUCTURES AND APPURTENANT WORKS unless the equipment is given a standard factory finish as allowed by other paragraphs of this specification. Insofar as is practicable, the complete coating system shall be applied to individual components and items before assembly to ensure complete coverage and maximum protection against corrosion. Equipment such as the pumps which have a factory-finished coating do not need to be recoated. Chips, scratches, and other damage to shop-applied painted surfaces shall be repainted in the field.

## 3.3 FIELD TESTS AND INSPECTIONS

### 3.3.1 Field Testing

The Contracting Officer shall be given 2 weeks notice before any test is to be conducted. Any material, equipment, instruments, and personnel required for the tests shall be provided by the Contractor. Testing shall be

conducted in the presence of the Contracting Officer unless waived in writing and then a certified test report shall be submitted in accordance with Paragraph: SUBMITTALS. Testing shall be done under the direction of the erection engineer or manufacturer's representative.

### 3.3.2 Proof Testing

The piping system shall be hydrostatically tested to not less than 125 percent of the design working pressure. Any equipment that might be damaged by this pressure shall be isolated or removed to prevent damage. The proof test pressure shall be maintained for 12 hours. All welded, flanged, flared, and threaded connections shall be carefully examined for leakage and all lines shall be inspected for evidence of deflection caused by inadequate anchorage. No leakage or deflection will be allowed.

### 3.3.3 Final Acceptance Tests

#### 3.3.3.1 General

In preparation for the final acceptance tests, and after completion of the installation and proof tests, the Contractor shall operate the hydraulic power system to prove acceptability. Preliminary tests shall be conducted at minimum pressures and velocities until initial adjustments have been proven safe for normal operation. Details of all operations shall be constantly monitored for signs of impending trouble and corrections shall be made as necessary to prevent damage to the equipment. At such time as the Contracting Officer may direct, the Contractor shall conduct the following complete acceptance tests on the hydraulic power system for approval. Any deficiency or maladjustment disclosed by the tests shall be corrected immediately and the test repeated until satisfactory results are obtained. No subsequent tests will be permitted until all preceding tests have been completed satisfactorily. Upon completion of the final acceptance tests, the Contractor shall furnish to the Contracting Officer a written statement that the hydraulic power system has been field tested and meets all operational requirements.

#### 3.3.3.2 Initial Start-Up

The hydraulic reservoir shall be inspected to ensure that the fluid is at the proper level. The accumulator precharge pressure shall be inspected and adjusted to the specified value. The hydraulic pumps shall be test started using both the controls at the control console and the remote controls. The pump shall be inspected for proper operation and discharge pressure. The discharge pressure of each pump shall be read and recorded. The pressure relief valves shall be adjusted to limit the system pressure to the specified value. The hydraulic lines and components which are under pressure shall be inspected for evidence of leakage and corrective measures taken to the satisfaction of the Government.

#### 3.3.3.3 Combined System Tests

Tests and inspections of each hydraulic power system shall be performed concurrently with the testing specified under other sections of these specifications which test the mechanism operated by the hydraulic system. The hydraulic system shall be tested by operating the mechanism through a minimum of four complete cycles. During each test operation, the hydraulic lines and components shall be inspected for evidence of leakage. The pressure in the supply and return lines for each direction of operation shall be read and recorded. Response of components to operation of

applicable controls shall be inspected to ensure that all connections have been made properly. Flow control valves shall be checked and adjusted as required to conform to specified operating requirements. Sequence valves shall be inspected and adjusted as required to obtain the indicated sequence of operation. Chokes in pilot circuits of pilot-operated valves shall be adjusted to obtain smooth, shock-free operation. Hand operated 4-way valves shall be checked and operated.

#### 3.3.3.4 Test Reports

The Contractor shall prepare and complete a test report showing in detail the results of the field tests. The test report shall include a detailed tabulation showing values of pressures, flow rates, and all adjustments recorded during the final tests, and adjustment and calibration of the entire system. During each test run, the following data and observations shall be recorded:

1. Control operation.
2. Voltages.
3. Currents.
4. Pressures.
5. Speeds and times.
6. Three gate operation - variation in gate position.
7. Flow control valve settings.
8. Alignment and operating clearances.
9. Excessive vibration by component.
10. Temperature of motors and hydraulic fluid.
11. Pertinent observations regarding such events as unusual sounds, malfunctions or difficulties encountered, and adjustments required.

#### 3.4 ERECTION ENGINEER(S)

The Contractor shall obtain the services of an experienced erection engineer(s) who is regularly employed by the hydraulic cylinder/power unit manufacturer to supervise the installation, start-up, adjustment and operation, and testing of the equipment provided. The erection engineer(s) shall furnish the Contracting Officer a signed statement stating that the final installation and start-up of the hydraulic power system has been inspected, witnessed, and complies fully with the manufacturer's warranty requirements. The erection engineer(s) shall also instruct the Government's operating staff members in the operation and maintenance features of the equipment. Any errors in the work done or work which does not conform to the manufacturer's instructions shall be corrected at no extra cost to the Government.

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## SECTION 14320

## GATE ROOM UNDERHUNG CRANE

## PART 1 GENERAL

## 1.1 GENERAL INFORMATION

The work to be done under this section consists of furnishing all plant, equipment, labor and materials, and performing all work necessary to complete the design and to fabricate, deliver, erect, install, paint, and test the regulating outlet (RO) gate room underhung bridge crane complete with underhung beams, monorail beam, hoist and controls.

## 1.1.1 Specification Drawings

The specification drawings indicate the extent and general arrangement of the hoisting equipment in the RO gate chamber. The electrical requirements for the hoisting equipment shall be as specified in SECTION: ELECTRICAL WORK, GENERAL. Equipment shall fit into the space provided and shall allow adequate and acceptable clearance for servicing and maintenance. The materials and equipment shall be new and unused and shall be the products of reliable manufacturers regularly engaged in the manufacture of such equipment. Where two or more items of the same type of equipment are required, they shall be the product of the same manufacturer.

## 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 325 (1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

Shop drawings with sufficient details, technical data and descriptive data shall be submitted in accordance with SECTION 01330: SUBMITTAL PROCEDURES. Shop drawings shall show the hook

coverage limits, high hook elevations and low hook elevations for all hoists. Shop drawings shall also show the bridge beam, runway beams, including layout, beam size, and details of the beam supports and connections.

#### SD-05 Design Data

##### Design Calculations; G

Design calculations for both static and seismic loading conditions shall be submitted in accordance with SECTION SUBMITTAL PROCEDURES. Seismic loading conditions shall be in accordance with SECTION 13080: SEISMIC PROTECTION FOR MECHANICAL AND ELECTRICAL EQUIPMENT. The crane shall be designed and constructed to CMAA Class A requirements. Forces due to earthquake shall be accounted for in the design, based upon requirements in Section 13080 of these Specifications.

#### SD-07 Certificates

##### Manufacturer's Certification; G

Crane manufacturer shall submit certification that fabrication of the 15-ton bridge crane equipment meet the requirements of CMAA specifications, SECTIONS 05120 and 13080: STRUCTURAL STEEL AND MISCELLANEOUS METAL and SEISMIC PROTECTION FOR MECHANICAL AND ELECTRICAL EQUIPMENT.

#### SD-10 Operation and Maintenance Data

##### Operation and Maintenance Manuals; G

Catalog data, parts lists, and operating and maintenance instructions for all equipment furnished under this section shall be submitted in accordance with SECTION 01330: SUBMITTAL PROCEDURES.

### 1.4 GUARANTEE

All hoisting equipment shall be warranted by the manufacturer to be free from defects in material, design, workmanship, installation, and operation for a period of five years from the date of acceptance thereof. Upon receipt of notice from the Contracting Officer of failure of this equipment during the warranty period, new replacement parts shall be furnished and installed promptly. Such repairs shall restore the operation of the hoisting equipment to its original level at no cost to the Government.

## PART 2 PRODUCTS

### 2.1 NAMEPLATES

Each unit of operating equipment shall have the manufacturer's name, address and model number on a plate securely attached to the item of equipment. Equipment and material sizes, dimensions, quality or capacities shall not be less than those indicated, regardless of tolerances allowed in testing and rating Standards or Codes.

### 2.2 DESIGN STRESSES

### 2.2.1 Beam

The beam used for the bridge beam structure shall be sized to accommodate end trucks and trolleys according to manufacturer's instructions. Materials shall be properly selected for the stresses to which they will be subjected according to SECTION 05120: STRUCTURAL STEEL AND MIS-CELLANEOUS METAL and CMAA Specification No. 74. Load carrying parts shall be designed so that the calculated static stress in the material, based on rated load, shall not exceed 20 percent of the assumed average ultimate strength of the material. This limitation of stress provides a margin of strength to allow for variations in the properties of materials and under no condition should imply authorization or protection for user to load the hoist beyond capacity.

### 2.2.2 Runway Beam Sizes

Runway beam sizes shown on the drawings must be verified by the manufacturer; beam design calculations and certification must be submitted by the manufacturer for both static and seismic loading conditions as specified in SECTION 13080: SEISMIC PROTECTION FOR MECHANICAL AND ELECTRICAL EQUIPMENT. Particular care shall be used in designing the beams and anchorage/supports for the beams spanning across the open area of the vertical tower.

### 2.3 BRIDGE

A bridge girder standard I-beam shape shall be fabricated for attachment to the crane end trucks. Adequately sized gusset plates shall be used at the end truck connection. The bridge girder shall be fitted with end stops to limit the hoist trolley travel. An outrigger support of either a structural steel channel or an outrigger truss of fabricated structural angles shall be furnished and be connected to the main girder to provide lateral reinforcement which will also form a horizontal truss and will provide supports for the squaring shaft bearings. A heavy structural steel motor mount shall be fabricated at the center of the span supported by structural steel cross-members that connect the main girder to the outrigger girder.

### 2.4 END TRUCKS

End trucks shall be fabricated of structural channels, gusset plates, axle bearing blocks, and heavy U-shaped end plates. The end trucks shall be welded in jigs to form a rigid structure and are designed to hold each crane wheel in a fixed position to prevent flange friction that would otherwise occur if the truck wheels were permitted to oscillate. The crane trucks shall be jig-bored to assure perfect alignment of all axles and jack shafts. Removable safety plates shall be furnished which will be bolted to the heavy U-shaped end plate.

### 2.5 BRIDGE DRIVE

The bridge drive shall consist of a motor reducer specially designed for crane and hoist duty, mounted at the center of the span. The crane shall be propelled by means of steel shafting supported in self-aligning precision ball bearing pillow blocks with hardened steel pinions keyed to the shafting driving two wheels at each end truck. All connections shall be flexible couplings keyed to the shafting.

### 2.6 TRUCK WHEELS

Crown tread, single flange, heavy-duty truck wheels machined from ASTM A 504 steel shall be furnished on the crane. The crown tread wheels shall provide point contact essential for smooth, efficient operation. The steel wheels shall be bored and machined to accommodate the wheel bearings and snap ring bearing retainers.

## 2.7 GEARS AND PINIONS

The flanges of the steel driver wheels shall be machined and hobbled for gear service. Gear teeth shall be 14-1/2 degrees involute full depth. The end truck pinions shall be keyed to the jackshafts, hardened to a Rockwell C44-48.

## 2.8 BEARINGS

The crane wheels shall operate on precision double row, permanently lubricated ball bearings. The squaring shaft shall be supported on self-aligning precision ball bearings equipped with dust seals and grease fittings. Self-aligning squaring shaft bearings shall be used to prevent bearing damage that might otherwise occur due to stress set up by bridge deflection under an overload condition.

## 2.9 AXLES

Removable wheel axle shall be furnished. The removable axle will permit the assembly of the crane wheels after the end trucks have been welded into a rigid structure and been jig-bored. The removable axle feature shall permit the removal of any crane wheel without the need for dismantling the crane end truck or the removal of the crane from the runway.

## 2.10 COUPLINGS

The jack shafts of each truck, the bridge drive shafts, the motor shafts and the squaring shafts shall be connected by means of flexible couplings. The sprocket teeth of these couplings shall be hardened to provide long wear. Flexible couplings shall be used at these points to relieve the stress that might otherwise occur on the shafts and bearings in the event of bridge deflection under an overload condition. All couplings shall be keyed to the shafts.

## 2.11 BRIDGE MOTORS

The bridge motor shall be of NEMA standard crane duty, enclosed ball bearing type and 30 minute, 55 degree rating design. Single speed alternating current motors shall be the squirrel cage type. The squirrel cage rotor windings shall be designed for frequent starting duty. The stator windings will have the proper number of terminal leads carried into the terminal box to allow reconnecting of those motors for either of the above voltages.

## 2.12 CONTROLS

The Contractor shall be responsible to design and furnish all electrical components and controls for travelling, traversing and hoisting operations of the crane. Pendant pushbutton station for raise and lower, and trolley controls shall be furnished and installed on, and move with the hoist. Length of pendant cable shall be 4 feet above the floor when hanging free. Pendant shall be supported by means of a strain chain or wire rope cable of

corrosion resistant steel. Control shall include pushbutton station control, magnetic reversing motor starters and fused control transformers.

#### 2.13 TRANSFORMER

In the case of alternating current, a transformer shall be furnished to reduce the pushbutton control circuit to 110 volts. This transformer shall have the proper number of input leads to allow reconnecting for either 220 or 440-volt service.

#### 2.14 CRANE WIRING

The crane shall be wired throughout using insulated standard copper wire in conduit. The crane shall be wired to meet the standard of the National Electrical Code.

#### 2.15 BRIDGE CONDUCTOR

Unless otherwise specified, bridge current conductors shall be provided. Conductors shall be festooned flat cable suspended from a track system along the span.

#### 2.16 SAFETY FACTOR

The factor of safety shall be a minimum of five (5) on all mechanical parts in accordance with normal conservative practice. All structural materials used in the construction of this crane shall conform to the specifications adopted by the American Institute of Steel Construction. The girder selected shall be of such size that the stresses produced by the full rated load, together with the weight of the hoist and trolley, shall not exceed one-fifth of the ultimate of the materials employed.

#### 2.17 BRIDGE CRANE

The hoist shall be designed for heavy-duty industrial use and shall be a wire rope electric hoist with a 15-ton capacity. The hoist shall be of the electric-driven trolley low headroom type. Hoist lift shall be 60 feet. Hoist lifting speed shall be 20 feet per minute. Hoist power shall be 460 volt, 3 phase. Bridge structure for the 15-ton bridge crane shall be an underhung, single girder fabricated assembly. End trucks shall have two wheels with one wheel on each truck driven by a common chain fall and shall allow bridge movement sufficient for the minimum coverage envelope as shown on the drawings. End trucks shall be custom designed as needed to accommodate the runway beams shown on the drawings. The ends of the bridge beam and runway beams shall be provided with end stops capable of stopping the hoist and the load at full traveling speed.

#### 2.18 CORD REELS

A cord reel shall be furnished for each hoist with swivel-type mounting base, 340 degrees free rotation to follow hoist. The cord reel for the 15-ton bridge crane shall be supplied with adequate length of cable to enable about 150 feet crane travel. Cord reels shall include adjustable 4-roller cable outlet, guide, factory assembled modular type collector ring and brush block assembly for proper alignment and brush tension, and shall be weather protected.

#### 2.19 BEAM CONNECTIONS

All bolted beam connections that are indicated or specified shall be assembled with high-strength bolts, nuts, and washers, which meet the requirements of ASTM A 325.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 General

The hoists, bridge beam, runway beams, and cord reels shall be installed in accordance with the manufacturer's printed instructions. The installation shall be accomplished by workers skilled in the type of work required. All equipment shall be properly and securely installed such that undue stresses are not exerted on the equipment and connections.

##### 3.1.2 Runway Beam Brackets and Anchor Bolts

The Contractor shall design and furnish all brackets and anchors for the runway beams. The brackets shall be fabricated and bolted to the beams with high-strength bolts, nuts, and washers as specified in SECTION 05120: STRUCTURAL STEEL AND MISCELLANEOUS METAL. The Contractor shall provide drawings showing location of all anchor bolts. All anchor bolts shall be of stainless steel.

##### 3.1.3 Crane

Once the crane has been installed and tested as specified in this section and have proved satisfactory, as determined by the Contracting Officer, the Contractor will be permitted to use crane for construction purposes. The Contractor shall provide power, maintenance, operators and other items required for use of the hoist and crane during construction, and shall assume responsibility for such use. The hoist and crane shall be operated in accordance with the requirements of the manufacturer's maintenance instructions. Upon completion of use and prior to acceptance, the Contractor shall, at no additional expense to the Government, completely check the crane and repair or replace any damaged parts and any parts which are worn beyond normal wear and tear. The crane shall then be completely serviced as specified herein. Each gear case shall have its lubricant replaced with new lubricant meeting the manufacturer's recommended specification. All other crane parts shall be lubricated, replaced or adjusted as recommended in the manufacturer's written annual maintenance procedure.

#### 3.2 PAINTING

After the equipment has been manufactured, all non-corrosion-resisting surfaces shall be prepared and painted according to the requirements of System No. 2 described in SECTION 09940: PAINTING: HYDRAULIC STRUCTURES AND APPURTENANT WORKS. All painted surfaces shall be protected from abrasion or other damage at all times.

#### 3.3 TESTING

With rated loads, the hoists shall be raised and lowered through the full ranges for at least two cycles and the operation of the trolleys and bridge drive observed over the full length of their travel and back. Any defects noticed shall be rectified by the Contractor to the satisfaction of the Contracting Officer without any extra cost.

### 3.4 TOOLS AND SPARE PARTS

#### 3.4.1 Tools

One set of tools required for assembly or disassembly of any of the equipment being supplied shall be furnished on an approved tool board. A list of all such tools shall be submitted with the **shop drawing submittal**.

#### 3.4.2 Spare Parts

A set of spare parts as recommended by the manufacturer shall be supplied. All spare parts shall be duplicates of the original parts they are intended to replace. Each spare part shall bear a tag or label securely attached clearly identifying the component for which it is intended. Spare parts shall include as a minimum:

1. One spare set motor brushes.
2. One spare motor starter for each motor.
3. One spare switch of each type.
4. One spare wheel and wheel bearing of each type supplied.

A complete list and description of spare parts shall be submitted with the **shop drawing submittal**.

### 3.5 SERVICES OF MANUFACTURER'S REPRESENTATIVE

The equipment supplier shall be required to provide one or more competent manufacturer's representatives who shall supervise and be responsible for the correctness of the Contractor's assembly procedures, method of alignment, installation of equipment and testing. When so requested, he shall also supervise and be responsible for initial starting and all subsequent operation of the equipment until the field tests are completed. The manufacturer's representative shall instruct the Contracting Officer for a minimum of one full day in the operation and maintenance features of the equipment. The manufacturer's representative shall cooperate fully with the Contractor, however, the work and operation of the manufacturer's representative shall be needed and the contractor shall be held responsible for any work done in the absence of the manufacturer's representative. Any errors in work done in the absence of the manufacturer's representative, or work which does not conform to the instructions issued by the manufacturer, shall be corrected at no cost to the Government.

### 3.6 QUALITY ASSURANCE

In accordance with the provisions of these contract documents, quality control shall be established and maintained for the hoisting equipment to assure compliance with the contract requirements.

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## SECTION 15095

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## SECTION 15095

## EMERGENCY CLOSURE GATES FOR REGULATING OUTLETS

## PART 1 GENERAL

## 1.1 GENERAL INFORMATION

This section covers all work including designing, furnishing, installing and testing two (2) 11-foot by 19.67-foot Emergency Closure Gates with two lifting (pick up) beams, and six (6) sets of gate frames, guides, seal seats, storage facilities and accessories for the Prado Dam Outlet Works.

Each emergency closure gate is intended to be normally stored in a suspended position above any of the six regulating outlet intakes by means of the storage facilities provided above in each intake as shown on the drawings. The closure gate will be picked up with the help of lifting beam from the storage position by means of a mobile crane from the deck at El. 520.0 and lowered under unbalanced water pressure conditions to shut off flow in case of any unforeseen emergency by closing the entrance of any of the intakes as may be needed. The gate will be normally raised under balanced water pressure. However, such raising operation may be needed to jog the gate up and down during emergency closure in case of any problems during such closure and the gates, lifting beams and accessories shall be designed for raising the gates against maximum unbalanced head.

The Contractor shall design all components of the gates, frames and lifting beam and accessories to safely withstand maximum forces during emergency operation and shall determine the crane capacity required. The estimated minimum crane capacity is 50 tons.

## 1.2 MANUFACTURER PREQUALIFICATION

The emergency closure gates, frames, lifting beams, and all other associated elements shall be the product of a manufacturer regularly engaged in the design and fabrication of water flow shut off gates of similar size and rating. The manufacturer shall submit documentation demonstrating experience in successful design, fabrication, installation and operation of comparably sized gates.

## 1.3 REFERENCES

The publications listed below form a part of this specification to the extent applicable.

1. AISC Manual for Steel Construction - Allowable Stress Design. (1989)
2. USACOE Manual EM 1110-2-2105, Design of Hydraulic Steel Structures.
3. Design Guidelines for High Head Gates - ASCE Hydro Gates Task Committee (Journal of Hydraulic Division, December 1955).

4. Handbook of Applied Hydraulics, Davis and Sorensen, Third Edition.  
(1984)

## ACI INTERNATIONAL (ACI)

ACI 318 (1995) Building Code Requirements for Reinforced Concrete

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B46.1 (1985) Surface Texture

ANSI Y14.5 (1994) Dimensioning and Tolerancing

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M (1998a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM A 36/A 36M (1997a) Carbon Structural Steel

ASTM A 276 (1998) Stainless Steel Bars and Shapes

ASTM A 564 (1995) Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes

ASTM B 22 (1995) Specification for Bronze Castings for Bridges and Turntables

ASTM D 395 (1989; R 1994) Rubber Property - Compression Set

ASTM D 412 (1998; Rev. A) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension

ASTM D 413 (1982; R 1993) Rubber Property - Adhesion to Flexible Substrate

ASTM D 471 (1996) Rubber Property - Effect of Liquids

ASTM D 572 (1988; R 1994) Rubber - Deterioration by Heat and Oxygen

ASTM D 2240 (1997e1) Rubber Property - Durometer Hardness

ASTM D 3951 (1995) Practice for Commercial Packaging

ASTM D 4541 (1995) Pull-Off Strength of Coatings Using Portable Adhesion Testers

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (2000) Structural Welding Code - Steel

## FEDERAL SPECIFICATIONS (FS)

FS RR-W-410C (1988) Corrosion Resistant Steel For Wire Ropes

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Shop Drawings; G

Shop drawings and catalog cuts for Contractor-designed details.

All drawings submitted by the Contractor shall have the Contractor's title and drawing number on each drawing. Drawings and data shall show specifications number. All dimensions shall be in feet and inches and all wording, signs, symbols, etc. shall be in English.

Approval Drawings and Data. As soon as practicable after date of award and before proceeding with fabrication or procurement of material, the Contractor shall submit to the Contracting Officer for approval, complete sets of shop drawings, material specifications design conform to the requirements. Any fabrication or procurement per formed, or shipment made, prior to approval of the drawings and data, shall be at the Contractor's risk. The Contracting Officer shall have the right to require the Contractor to make any changes in the equipment design which the USACOE determines necessary to make the equipment conform to the requirements of these specifications without additional cost to the Contracting Officer. Approval by the Contracting Officer of the Contractor's drawings or data shall not be held to relieve the Contractor of responsibility to meet all of the requirements of these specifications or of the responsibility for the correctness of the Contractor's designs and drawings.

Where approval data are required for commercial products or equipment, the Contractor shall submit complete identifying data giving the manufacturer's name, type model, size, and characteristics of the equipment. When a catalog sheet is submitted, the particular item proposed shall be underlined or marked. The data shall be comprehensive and shall fully demonstrate that all equipment provided shall meet the requirements of these specifications. One copy of the approved data will be returned to the Contractor.

## SD-05 Design Data

Design Calculations; G

Together with the shop drawings, Contractor shall submit complete set of detailed design calculations for the gates,

frames, lifting beams and storage facilities, including all accessories and appurtenances. The calculations shall be in English and shall use feet, inches and pounds. The calculations should be self-explanatory and shall include copies of all reference materials and data.

#### SD-06 Test Reports

Test Data; G

During the shop tests, all data needed for proper evaluation of the performance of the equipment shall be recorded. All test data shall be submitted for approval. If the test data do not demonstrate compliance with the specified requirements, all required remedial actions shall be performed and the necessary tests shall be repeated until complete compliance is demonstrated.

#### SD-08 Manufacturer's Instructions

Installation Instructions; G

The Contractor shall furnish detailed installation instructions, with sequence of installation, drawings, methods of handling and alignment procedures, installation tolerances, special tools and installation equipment needed.

#### SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals; G

Operating and maintenance manuals shall be submitted for all equipment specified in this Section. The manuals shall include complete parts identification lists and detailed instructions for the operation, lubrication and maintenance of the equipment and for ordering replacements. The manual shall be subject to approval by the Contracting Officer.

### 1.5 Specification Drawings

The specification drawings indicate the general arrangement, clearances (necessitated by structure and other equipment), maximum overall dimensions and other suggested pertinent features. The Contractor shall be entirely responsible for all design and shall prepare designs and shop drawings in conformity with the specifications and design criteria included in the solicitation. The Contractor shall submit design calculations, shop drawings and catalog data for approval prior to manufacture. The design details, welds and other sizes or dimensions of structural members, shown on Specification drawings as "minimum" are minimums and shall be adopted by Contractor at his discretion.

### 1.6 DESIGN AND PERFORMANCE REQUIREMENTS

#### 1.6.1 General

The Contractor shall design in conformity with these specifications and references listed in paragraph: REFERENCES as applicable and the following design criteria.

#### 1.6.2 Design Parameters

## 1. Design Data

Gate Sill Elevation	470.0
Operational Design Head Gate Sill	50 Feet Measured from Gate Sill
Nominal Gate Width	11 Feet 0 Inches
Nominal Gate Height	19 Feet 8 Inches
Type of Gate	Highhead Fixed Wheel Type
Type of Hoist	Mobile Crane
Hydrostatic Design Head	96 Feet from the Gate Sill
Minimum Gate Weight Including Ballast	40,000 Pounds
Number of Wheels	20
Minimum Wheel Diameter	24 Inches
Required Minimum Crane and Lifting Beam Capacity	50 Tons

2. Each gate shall be designed to be suitable for satisfactory and reliable emergency closure under gravity without vibrations, cavitation, oscillations or seizing or galling problems under unbalanced head up to a maximum of 50 feet above the gate sill.

3. Downpull. Downpull on the gate shall be calculated based upon Hydraulic Design Criteria, Sheets 310-2 through 320-2/3 (Revised 10/61) of the U.S. Army Corps of Engineers included in these specifications on the following pages, or other acceptable methods based upon hydraulic model studies on similar installation.

4. Gate Deflection. The maximum allowable deflection of the gate shall be less than 1/1,000 of the span.

5. The gate will be normally raised under balanced pressure condition only unless required to be raised under unbalanced head due to problems during closure operation.

## 1.6.3 Allowable Stresses

The allowable stresses shall be as specified in EM-1110-2-2105, U.S. Army Corps of Engineers Manual for Design of Hydraulic Steel Structures. Where stress conditions and materials are not covered in EM 1110-2-2105, the following shall govern.

## 1.6.3.1 Tensile and Compression Stresses

For tensile and compression stresses, the smaller of the values given below will be allowed:

a. For rolled, forged or stainless steel, the tensile and compression stresses shall not exceed 40 percent of yield point or 25 percent of

ultimate strength or 16,200 psi, whichever is lower.

b. For rolled or forged steel bolts, the maximum tensile or compression stresses shall be limited to 25 percent of yield point or 16.5 percent of ultimate strength, whichever is lower.

c. For cast steel, the maximum tensile and compression stresses shall be limited to 33 percent of yield point or 20 percent of ultimate strength, whichever is lower.

d. For cast iron, the maximum tensile strength shall be not greater than 16.5 percent of ultimate strength.

e. For brass or bronze, the maximum tensile and compressive stress shall not exceed 33 percent of yield point or 16.5 percent of ultimate strength, which ever is lower.

#### 1.6.3.2 Maximum Stress for Shear

For shear, the maximum stress shall be less than 0.6 times the allowable tensile stress, except for cast iron, the permissible shear stress shall be equal to the allowable tensile stress.

#### 1.6.3.3 Bearing Stress

Bearing stress between the wheel axle and self-lubricating bronze bushing shall not exceed 6,000 psi or as recommended by the bushing manufacturer.

#### 1.6.3.4 Wheel Friction Formula

The following formula shall be used to estimate the wheel friction:

$$\text{Friction} = P/R(f_a \times r + f_r)$$

Where:

P = Total Waterload on the Gate

R = Wheel Radius

r = Wheel Axle Radius

f<sub>a</sub> = Coefficient of Static Friction = 0.2

f<sub>r</sub> = Coefficient of Rolling Friction = .02

#### 1.6.3.5 Corrosion Allowance

A corrosion allowance of 1/16 inch for structural steel members subject to submergence shall be made.

#### 1.6.3.6 Coefficient of Friction

The coefficient of friction between teflon clad rubber seal and stainless steel shall be assumed as 0.20.

#### 1.6.3.7 Bearings and Bushings.

a. General. Average bearing pressures shall be calculated by dividing

the bearing load by the effective projected area (diameter multiplied by length for round items) of the bearing. Maximum local bearing pressures shall be calculated for unsymmetrically loaded bearings and bushings assuming non-uniform linear pressure distribution along the length of the bearing. When calculating maximum local bearing pressures due to shaft deflection, it shall be assumed that the steel shaft is incompressible and bearing pressures are proportional to the compression of the bearing material.

b. Permanent Self-Lubricating Bushings on Corrosion-Resistant Steel Pins.

Average bearing pressure for permanent self-lubricating bearings for normal loading condition shall be two-thirds of the values recommended by the permanent self-lubricating bearing manufacturer, but in no case higher than 4,200 pounds per square inch. The allowable average bearing pressure shall not exceed 5,000 pounds per square inch for overload condition. For maximum allowable local bearing pressures, the values may be increased by 20 percent.

c. Bearing Plates. Loads on bearing plates shall be calculated assuming uniform load distribution and with the normal or overloads loads acting on the gate structure. For rounded plates in contact with rounded or flat plates, the design shall be based on contact (Hertz) stress. Maximum allowable contact (Hertz) stress shall not be more than 135 percent of the minimum ultimate strength of materials for normal loading condition and not more than 150 percent for overload conditions. For hardened steel materials, the allowable contact (Hertz) pressure in pounds per square inch shall be 775 x BHN for normal load condition and 1,065 x BHN for overload condition.

#### 1.6.3.8 Gate Wheels and Track Plates

a. General.

Wheels and track plates shall be checked using maximum wheel load on a single wheel resulting from normal loading conditions on the lower gate section. Wheel treads and track plates shall be hardened as required. Track plates shall have a hardness at least 50 point Brinell hardness number (BHN) higher than the wheel treads. The track plates shall be flat.

The wheels shall be cylindrical with provisions to ensure uniform load distribution along the contact line and to avoid stress concentrations due to edge loading. The provisions shall include the use of a self-aligning bearing to permit rotation of the wheel axle due to deflection of the gate under load, adequate clearances to prevent metal-to-metal contact when the axle rotates, and adequate strength of rubber seals in the wheel assembly to withstand the compression caused by the rotation of the wheel axle. Crowned wheels on cylindrical bushings shall not be used without USACOE's approval.

b. Track Plate Mounting.

Track plate shall be mounted to the embedded backing plate by welding. The thickness of the track plate shall be adequate not only for structural strength but also to ensure that the hardness of the track plate surface in contact with the wheels is not affected by welding of the track plate to the embedded backing plate and seal plate, as applicable. The stresses in the track plate to backing plate connection shall not exceed the normal values at load corresponding to a hydrostatic pressure over the entire area of contact between track plate and backing plate equal to a water load of 1.0 times the maximum static head on the track plate, assuming no

compensating forces on external surfaces of track plate or backing plate. It shall be ensured that the concrete beneath the wheel track shall safely withstand the stresses induced by maximum wheel loads. The Contractor shall submit detailed calculations to verify the adequacy of track and track plate mountings.

c. Allowable Wheel Load.

1. Cylindrical Wheels on Flat Tracks. Allowable maximum wheel load shall be:

$$P = \frac{1}{2} (24.5 \times \text{BHN} - 2,200) \times L \times D$$

P = Maximum wheel load, in pounds.  
 BHN = Minimum Brinell hardness number of wheel tread  
 L = width of wheel, inches  
 D = diameter of wheel, inches

2. Crowned Wheels on Flat Tracks. Crowned wheels shall have a diameter ratio (diameter of crown in a section through the axis of the wheel divided by wheel diameter) not exceeding 15. Wheels shall be checked for maximum contact (Hertz) pressures, using maximum wheel load induced by normal loading conditions. Maximum allowable contact (Hertz) pressure in pounds per square inch shall be 775 times the Brinell Hardness Number of the wheel crown.

1.6.3.9 Standard Products

The allowable stresses in all anchor bolts, bearings or other standard manufactured products shall not exceed 90 percent of the values recommended by the manufacturer. Lower allowable stresses shall be utilized wherever necessary or desirable.

1.6.3.10 Concrete

Embedded parts in the concrete structure and parts bearing on the concrete structure shall be designed in accordance with the requirements of ACI 318 and based on a concrete 28-day compressive strength of 4,000 psi. A load factor of 1.7 shall be used for all water loads, and the combined factor dead and live loads shall be multiplied by a "Hydraulic Structural Factor",  $H_f = 1.3$ , to compute the required strength, U. When loads from earthquake, overload operating forces, or wind are included,  $H_f$  shall be multiplied by 0.75.

1.6.3.11 Operating Forces

a. Force Components

1. General. For calculating the operating loads, either the maximum or minimum value shall be applied to each one of the force components, as shown on Table 1, so that the most conservative results are obtained. It shall normally be assumed that force components act symmetrically except if the design is asymmetrical.

2. Weight. The nominal gate weight component shall include the weight of the ballast (if any), weight of all gate-mounted equipment including the components connecting the gate and crane, and the weight of trapped water, as applicable. Maximum weight shall be calculated by addition of silt load that can accumulate on gate members to the nominal weight.

3. Buoyancy. the nominal buoyancy shall be calculated using the volume of the gate including ballast and any other gate-mounted equipment. Maximum buoyancy shall be calculated by adding the buoyancy due to trapped air to the nominal buoyancy, unless it can be demonstrated that venting of the entrapped air will occur at the same rate as the gate is being closed and assuming specific gravity of water and 1.1 to allow for silt.

4. Hydrostatic Effects. Nominal magnitude of hydrostatic effects shall be calculated using the design geometry of the part or detail under such effect and the applicable hydrostatic pressures. Hydrostatic loads shall be calculated with a specific weight of 62.5 pounds per cubic foot for fresh water.

5. Hydrodynamic Effects. For the wheel gate, the magnitude of hydrodynamic uplift and downpull forces specified in these Specifications shall be considered as the applicable maximum without the need for additional allowances for the gate having characteristic dimensions (gate thickness, location of bottom seal, gate bottom slope, clearance between gate downstream face and concrete wall) within  $\pm 5$  percent of those shown on the Plans. If the characteristic dimensions are changed during the Contractor's design, new maximum or minimum values, as applicable, shall be established by calculating the theoretical hydrodynamic forces considering the maximum for minimum possible affected areas, maximum or minimum pressure difference, maximum or minimum flow velocities, and other assumptions. Then, at least 15 percent shall be added for the maximum value and 15 percent shall be subtracted for the minimum value.

6. Friction Forces.

(a) General. Maximum friction forces shall be calculated using maximum normal forces and maximum friction coefficients. Minimum friction forces shall be calculated using minimum normal forces and minimum friction coefficients. A differential pressure of 5 psi shall be assumed on the gate during normal raising operation to account for possible leakage through the regulating gate.

(b) Seal Friction Force. The seal friction force shall be calculated by summing the friction caused by the hydrostatic water load acting on the seal and the seal pre-compression force. The pre-compression force shall be used as given by the seal manufacturer or if such data are not available, pre-compression forces shall be determined by tests made by the Contractor. The following seal friction coefficient shall be used in accordance with conservative engineering practice.

Item	Maximum	Minimum
Rubber on steel	1.0	0.3
Rubber on corrosion-resistant steel	0.8	0.2
Fluoro-carbon on corrosion-resistant steel	0.15	0.05
Bronze on corrosion-resistant steel	0.5	0.15

(c) Sliding Friction Forces. Sliding friction forces for gates and guide shoes shall be calculated using the following

minimum and maximum friction coefficients based upon standard engineering practice.

Item	Maximum	Minimum
Corrosion-resistant steel on carbon steel, non-lubricated	0.5	0.1
Corrosion-resistant steel on corrosion-resistant steel	0.18	0.08
Corrosion-resistant steel on corrosion-resistant steel	Not Acceptable	
Bronze on corrosion-resistant steel, non-lubricated	0.4	0.1
Bronze on corrosion-resistant steel, lubricated	0.2	0.07
Self-lubricating bearing on corrosion-resistant steel	0.2	0.06

(d)) Guiding Device Friction. Friction forces shall be calculated using the average operating load on the guiding device and the applicable maximum and minimum friction coefficients.

7. Wheel Gate Bottom Seal Compression Force.

(a) Bottom seal compression force shall be calculated by dividing the sill reaction due to the nominal weight of the gate minus the maximum frictional forces and the buoyancy, when the gate is nearly closed, by the length of the bottom seal.

(b) Bottom seal compression force shall not be less than 250 pounds per foot length of seal.

8. Loading on Wheel Gate Guiding System.

(a) General

(1) The loads specified below shall be used for designing the embedded guiding devices with their anchorage as well as gate-mounted guiding devices with their anchoring and supporting structures including all affected gate parts; they shall also be used for defining force components to be used in operating loading combinations.

(2) Loads that do not cause rotation of the gate shall be considered acting evenly distributed among all participating guiding devices of a rigid gate. Reactions to loads causing rotation in the plane of a rigid gate shall originate only at the upper guiding device on one side and at the lowest guiding device of the opposite side. Reactions causing twisting moment around a horizontal axis in the plane of a rigid gate shall originate only at the upper pair and at the lowest pair of guiding devices.

(3) Forces and reactions on each guiding device shall be considered uniformly distributed over the design contact area. Minimum engagement shall be considered for defining the design contact area.

(4) For guide rail design, the guiding device shall be

considered located both at a guide rail anchorage and also in between a pair of anchorages except for loading conditions corresponding only to a definite position such as for closed or dogged gate section.

(b) Loads of Static Origin.

(1) Loads caused by the geometry, eccentricity of weights and forces, and similar effects related to the arrangement of the equipment shall be determined by customary force calculations. These loads shall correspond to effects such as the following:

direction of pull outside the plan of guides and

seating plane of the closed gate off the plane of center of gravity.

(2) Other loads of static origin such as precompression of seals, reverse water loading, and similar effects shall also be considered.

(c) Guiding Effort and Water Turbulence.

(1) When the gate is not submerged, the guiding effort required to counteract the tendency of gate swinging shall be considered as at least 5 percent of the weight or a surface loading of 4 pounds per square foot, whichever is higher, in either horizontal direction. The gate area to be considered in either direction shall be the projected area of the gate outline.

(2) Effects of water turbulence for all locations where the gate is partially or fully submerged shall be computed on the basis of 20 pounds per square foot differential water load acting on the projected area of the gate outline.

(d) Unsymmetrical Resistance to Operation.

(1) General. Forces parallel to the gate movement and horizontal forces in the plane of the gate due to rotation shall be considered in the manner listed below.

(2) Normal Blocking Load in Lowering. Gate moving downward and stopped by a resistance ("blocking force") at one lower fixed guiding device at one guide. Acting forces shall be the average acting weights of gate and gate-mounted accessories. The acting forces will be partially balanced by the friction forces originated at the two guiding devices receiving horizontal reactions; the remainder of the acting forces shall be balanced by the "blocking force".

(3) Extraordinary Blocking Load in Lowering. This loading condition shall be determined as for the "Normal Blocking Load in Lowering", except that the maximum downward thrust of the hoist shall be used rather than the average acting weight.

(4) Normal Blocking Load in Raising. Gate moving upward and stopped by a resistance ("blocking force") at one upper guiding device at one guide. Acting force shall be the rated pull capacity of the hoist less the weight of the gate. The acting

force shall be partially balanced by the friction forces originated at the two guiding devices receiving horizontal reactions; the remainder of the acting forces shall be balanced by the "blocking force."

(5) Extraordinary Blocking Load in Raising. This loading condition shall be determined as for the "Normal Blocking Load in Raising", except that the maximum pull capacity of the hoist shall be used rather than the rated capacity.

(e) Earthquake Loading. Earthquake forces shall be determined in accordance with Section 13080 of these Specifications.

(f) Normal Loading Combinations. Normal loading on guiding devices shall be obtained by combining the following loads wherever applicable:

Loads of static origin.

Loads due to guiding effort and water turbulence.

Normal blocking loads.

(g) Overload Combinations. Overload combinations on guiding devices shall be obtained by either one of the following summations of applicable loads:

Loads of static origin, loads due to guiding effort and water turbulence, and extraordinary blocking load in raising or lowering

Loads of static origin and loads due to guiding effort and water turbulence.

Loads of static origin combined with earthquake loading.

#### 1.6.3.12 Combination of Force Components

a. Force components shall be combined according to Table 1, "Force Combination Cases", to establish the required operating forces in accordance with standard practice.

b. Where all force components act parallel to each other and the hoist pull, Table 1, "Force Combination Cases", shall be used directly. Where force components are not parallel to each other and to the hoist pull, the moments (around the axis of rotation) caused by the force components shall be used.

TABLE 1  
FORCE COMBINATION CASES

Application Force Components	Force Combination Cases		
	I Safety of Closure	II Normal Pull	III Forces on Crane During Lowering Operations
Weight	+ 0.95 Nom.	+ 1.05Max.	+ 1.05 Max.
Buoyancy	-1.05 Max.	- 0.95 Nom.	- 0.95 Nom.
Hydrostatic Uplift	- 1.1 Nom.	- 0.9 Nom.	0
Hydrostatic Downpull	0	+ 1.1 Nom.	+ 1.1 Nom.
Hydrodynamic Uplift	- 1.2 Max.	- 0.8 Nom.	0
Hydrodynamic Downpull	0	+ 1.2 Max.	+ 1.2 Max.
Wheel, Seal and Guide Friction	- 1.3 Max.	+ 1.3 Max.	- 0.8 Min.

#### 1.6.4 Materials

The following materials and material specifications shall be used. If the bidder intends to substitute any of the materials, he should clearly state so in **the shop drawing submittal** and the reasons for substitution. He shall submit the specifications for such alternative materials.

1. Gate leaf, frames, guides and lifting beam shall be of structural steel conforming to ASTM A 36/A 36M.
2. Gate seal seats shall be of stainless steel conforming to ASTM A 276, Type 316.
3. Wheel track shall be of stainless steel conforming to ASTM A 564, Type 630.
4. Gate wheels shall be of stainless steel conforming to ASTM A 564 Type 630.
5. Wheel pins shall be of stainless steel conforming to ASTM A 276, Type 316.
6. Seal fasteners shall be of stainless steel conforming to ASTM A 276, Type 316.
7. Permanent self-lubricating bronze bearings shall be of cast bronze alloy conforming to ASTM B 22, Alloy 863 with self-lubricating inserts, Lubrite or equal.
8. Wire ropes shall be of corrosion resistant steel conforming to FS RR-W-410C 1 WRC.
9. Wire rope fittings shall be of corrosion resistant steel conforming to Manufacturer's Standards.
10. Lubricating fittings shall be Alemite, Type A-1188 or A-1184, as manufactured by Alemite division of Stewart Warner Corp., 1826 West Diversey Parkway, Chicago, IL 60614, or equal.
11. Grout for machinery shall be non-shrink epoxy grout.

12. Fluoro-carbon (PTFE) bushings and washers shall be "Rulon A" as manufactured by the Dixon Industries Corporation, Bristol, RI 02809, or equal.

13. High strength fiber-reinforced phenolic bearing material shall be "ORKOT TLM" as manufactured by ORKOT Engineering Plastics, 2535 Prairie Road, Unit D, Eugene, Oregon 97402, or equal. **ORKOT TLM shall not be used for sliding bearing surfaces.**

14. Neoprene seals shall be molded of neoprene compound or copolymer of butadiene and styrene or a blend of both. The compound shall contain not less than 70 percent by volume of the basic polymer, and the remainder shall consist of reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers conforming with Tensile Strength 3,000 psi - ASTM D 412, Elongation at Break 450 percent, Water Absorption by Weight 5 percent - ASTM D 471, Compression Set 30 percent of Original - ASTM D 395.

15. Fluoro-carbon clad rubber seals shall be Rubber seals shall be as specified above. A fluoro-carbon sheath shall be bonded to the rubber on the sealing surface. The sheath shall be abrasion resistant Fluoro-Carbon Film No. 4508 as manufactured by Buckhorn, Inc., 55 West Technecenter Drive, Milford, OH 45150, or equal. The outside surface of the fluoro-carbon sheath shall be free of adhering or bonded rubber conforming with ASTM D 412, ASTM D 2240, ASTM D 471, ASTM D 395, ASTM D 572, and ASTM D 413 (Friction Test).

16. Elastometric sealing rings (O-rings) shall be Vulcanized compound of Nitrile Butadiene Rubber. Durometer A hardness 55±5. Tensile Strength 2,500 psi minimum.

17. Lubricating oil shall be ISO VG 46, Mobil D.T.E. Oil Medium or Shell Turbo Oil T46, or equal.

#### 1.6.5 Anchors and Alignment Provisions

The Contractor shall be responsible to design and provide adequate number of anchors welded to the gate frames. These frames, together with anchors, should be designed for external water load equal to the maximum pool pressure. External tension anchors shall transfer the water load to the concrete by compression and/or bearing and shall prevent the gate frames from collapsing inward if leakage occurs around them. The allowable tensile and bending stresses in the structural steel members and anchors shall not exceed 16,200 pounds per square inch.

The Contractor shall also provide adequate alignment anchors with turnbuckles to permit precise alignment of the gate frames. Provisions such as seats welded to frames for hydraulic jacks and other erection tackle shall be made.

#### 1.6.6 Surface Roughness and Finish

The Contractor shall indicate on his submittal drawings the surface roughness specified by numbers in check-type marks on the surfaces, which shall be machine finished and shall conform to the surface quality specified in ANSI B46.1, entitled, "Surface Texture", published by ANSI.

#### 1.6.7 Tests of Materials

#### 1.6.7.1 General

All materials or parts used in the equipment shall be tested, unless otherwise directed, in conformity with applicable methods prescribed by the ASTM, or such other organizations as may be specifically required, and in general accordance with the best commercial methods. When requested, tests shall be made in the presence of the Government representative. Stocked material may be used provided evidence is furnished showing that such material meets the specified requirement, in which case tests on stocked material may be waived.

#### 1.6.7.2 Test Reports

Certified material test reports shall be furnished. The test reports shall identify the component for which the material is to be used and shall contain all information necessary to verify compliance with the Specifications.

#### 1.6.8 Workmanship

##### 1.6.8.1 General

a. All work shall be performed and completed in a thorough workmanlike manner and shall follow the best modern practices in the design and manufacture of gates and hoists. All work shall be done by personnel skilled in the related professions and trades. All parts shall be made accurately to standard so as to facilitate replacement and repairs. All bolts, nuts, screws, rivets, threads, pipe, gages, gears and measurements or dimensions shown on the Plans shall conform to U.S. standards. Dial special gages and templates necessary for field erection of the wheel gate shall become the property of the Government.

b. Like parts and spare parts shall be interchangeable wherever possible. Machining of fits on renewable parts shall be accurate and to specified dimensions so that replacements made to the size shown on the shop drawings may be readily installed.

c. The design and fabrication of the wheel gate equipment shall provide for adequate adjustment (by the use of shim plates or oversized holes) so that there are minimal interfacing difficulties during erection.

##### 1.6.8.2 Welding

a. General. All welds shall be continuous and watertight. All welding shall be performed by the electric-arc method, by a process that excludes the atmosphere from the molten metal, and where practicable, by automatic machines. Machined surfaces of parts affected by welding shall be machined to final dimensions after welding. Machined surfaces of parts requiring stress relief shall be machined to final dimensions after the parts have been stress relieved. Localized stress relieving will not be permitted for shop welded parts.

b. Minimum Weld Requirements. All welds shall be made continuous and watertight. The minimum size of fillet welds shall be 1/4 inch measured on the leg except if otherwise specified. Welds larger than 5/16 inch shall be made in not less than 2 passes. All groove welds including butt welds shall be full penetration, welded from both sides.

c. Preparation of Base Material. Members to be joined by welding shall

be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conduits. The design of welded joints and the selection of weld filler metal shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces (up to the thickness of the metal) to be welded shall be sound metal free of visible defects, such as laminations or defects caused by cutting operations, and free from rust, oil, grease, and other foreign matters.

d. Technique of Welding. The technique of welding, the appearance and quality of the welds, and the methods used in correcting defective work shall conform to the AWS D1.1. Special care shall be taken to avoid undercuts along the seams or warping of the structure. If undercuts appear along the welds, they shall be filled using a small diameter electrode of the same composition as the original electrode after slag, if any, is removed. Continuous and uniform maintenance of preheat and interpass temperatures will be required for all welds. Local preheating shall be used only for repairs on welds. Preheat and interpass temperature shall also be as outlined in the welding procedure according to the applicable sections of AWS D1.1 or ASME Code, Division 1.

e. Welding Qualifications. The qualification of welding procedures, welders, welding operators, and tackers shall conform to standards at least equal to Section 5, "Qualification" of AWS D1.1. The Contractor shall furnish all facilities and all equipment, materials, and other articles required to conduct qualification tests of his welders and welding operators. Certificates of welders' qualifications shall be submitted when requested.

f. Weld Finish. Welds shall, in general, be treated so that they will display good appearance and a surface suitable for painting. Structural welds shall be ground and blended to avoid stress raisers. All welds which require nondestructive examinations shall be dressed by chipping and grinding as required for good interpretation by the selected weld examination methods.

g. Environmental Requirements. Recommendations of the ASME Code, Section VIII, Division 1, Paragraph UW-30, shall be observed for temperature and weather conditions for welding.

#### 1.6.8.3 Castings

a. General. Castings shall be free from injurious defects and shall be satisfactorily cleaned for their intended use. All bronze castings for bushings and bearings shall be centrifugally cast unless approved otherwise. Surfaces of castings which are not machined shall be dressed for good appearance and for painting. The location of existing defects shall be determined, and all defects which impair the strength or utility of the casting shall be removed to sound metal before repair. The structure of the castings shall be homogeneous and free from excessive nonmetallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in the casting will be cause for its rejection.

b. Repair Welding. Minor defects that will not impair the strength or serviceability of the castings may be repaired by welding in accordance with accepted foundry practice without review by the Contracting Officer. Defects shall be considered minor when the depth of cavity properly prepared for welding is not greater than 25 percent of the actual wall

thickness but in no case greater than 3/4 inch and when the area to be welded is smaller than 8 square inches. However, an accumulation of minor defects which, in the opinion of the Engineer, casts doubt as to the general quality of the casting shall be considered as a major defect. A complete descriptive report of major defects, supplemented with sketches, photographs, and metallurgical test reports, as the case may warrant, and the proposed reaper procedure shall be submitted for review prior to any repair of major defects. If removal of defects reduces the stress-resisting cross-section of the casting by more than 30 percent, the casting may be rejected. All castings repaired by welding of major defects after heat treatment shall be heat treated again.

#### 1.6.8.4 Nondestructive Testing

a. General. Unless otherwise indicated, all nondestructive tests shall be in accordance with the applicable sections of ASTM Volume 03.03. The shop drawings shall define the areas, extent and type of nondestructive examinations to be employed. Personnel who perform or interpret nondestructive tests shall be qualified in accordance with ASNT Recommended Practices No. SNT-TC-1A 1988 Edition # 2045, Level II or III.

b. Examination of Welds. All critical welds, including all welds on primary structural components, shall be given complete nondestructive examination by radiographic, ultrasonic, magnetic particle, or dye-penetrant methods, as applicable or specified, throughout the entire length. Full penetration welds shall be given nondestructive examination throughout their entire length by radiographic examination. Where radiographic examination is not feasible or results are likely to be doubtful, ultrasonic supplemented by magnetic particle or liquid penetrant methods shall be used. All welds (100 percent) shall be inspected visually throughout their entire length. The Contracting Officer shall have the right to request random spot-check examination of welds, including radiographic examination, as part of the equipment inspection. Examination of welds shall be in accordance with the technique and acceptance standards of Section VIII, Division 1, of the ASME Code. Ultrasonic examination shall meet the technique and acceptance standards as defined by ASME Code, Section VIII, Appendix 12. Radiographic examination shall meet the technique and acceptance standards of Paragraph UW51, Section VIII, Division 1, of the ASME Code. Magnetic particle and liquid penetrant examination shall meet the technique and acceptance standards as defined by ASME Code, Section VIII, Division 1, Appendices 6 and 8, respectively. Where stress relieving is required, nondestructive examination shall be performed after stress relieving.

#### c. Examination of Castings

1. Castings for major components shall be given a complete ultrasonic examination and a radiographic examination insofar as practicable. No casting will be accepted having defects larger than those indicated under (14.13), C.2. Repair Welding, above. Where radiographic examination is not practicable due to configuration or accessibility, other nondestructive examination, subject to the Contracting Officer's review, may be substituted.

2. Inspection. Castings shall be inspected visually at the foundry after they are cleaned and while defects are being removed. Castings shall also be inspected after repairs and after heat treatment. Radiographic or other nondestructive tests will be required as specified and as directed when permission is granted to repair major

defects. The Contracting Officer shall have the right to require nondestructive tests at the Contractor's expense to determine:

- (a) The full extent of defects.
- (b) That the area is properly prepared for welding.
- (c) That the repairs are satisfactory.

d. Examination of Forgings. Major forgings shall be given ultrasonic examination with liberal overlap and other applicable nondestructive tests, to determine that they are sound. Nondestructive examination of minor forgings shall be in accordance with accepted good practice to assure their soundness. The structure of forgings shall be homogeneous and free from excessive nonmetallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a forging will be cause for its rejection.

#### 1.6.8.5 Machine Work

a. General. Sufficient machining stock shall be allowed on all parts to be machined to ensure true finished surfaces of solid material.

b. Finished Surfaces. In addition to the machined surfaces indicated on the specification drawings, all surfaces that require machining for their intended function and those surfaces that are normally machined in good shop practice shall be machined. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to insure proper operation when assembled. No machining shall be done on working surfaces of self-lubricating bushings or washers. Corrosion-resistant-steel, seal plate surfaces in contact with seals shall be thoroughly cleaned and machined to have a smooth and even surface.

c. Pins and Pin Holes. Pin holes shall be drilled smooth and straight and at right angles to the axis of the member. The drilling shall be done after the member is securely fastened in position and shall be line bored in one set-up where practicable.

d. Unfinished Surfaces. All work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined, to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown on the specification drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts may be filled in an approved manner.

e. Assembly. Before assembly, all bearing surfaces, journals and grease and oil grooves shall be carefully cleaned and lubricated with an approved oil or grease. After assembly, each lubricating system shall be filled with an approved lubricant. Self-lubricating bearings shall be treated according to the manufacturer's instructions.

#### 1.6.8.6 Tolerances

a. General. All tolerances shall be selected to correspond to the accuracy required for the proper operation of the equipment considering the

nature and function of the part. Plate thicknesses shall be governed by ASTM A 6/A 6M.

b. Designations. Tolerances shown on the Plans and specified elsewhere in these Specifications have been designated as follows: dimensional tolerances for cylindrical parts in the ISO system, position and form tolerances in accordance with ANSI Y14.5, and surface finish designations in accordance with ANSI B46.1. Surface finish designations are in micro inches as determined by the root-mean-square (RMS) method. The Contractor shall use these same standards for symbols and designations, or shall submit with the first review shop drawings alternative designation codes and their correspondence with the specified standards.

c. Selection

1. General. The tolerances specified in these Specifications and on the Plans are maximum tolerances applicable to the equipment when it is installed. Finer shop tolerances shall be established, if necessary, to meet the specified design or operational requirements or for interchangeability of spare parts. All tolerances shall be selected with due consideration to the nature and function of the parts, to the effects of cumulative tolerances and to the corresponding accuracy required to secure proper operation, but they shall not exceed the tolerances specified below.

2. Wheel Gates

(a) Skinplate. Bottom and top edge of the skinplate of each gate section shall be parallel within  $\pm 0.010$  inch per 5 feet of height. Length of diagonals connecting skinplate corners shall be within  $\pm 0.003$  inch for any 5 feet of skinplate perimeter but in no event shall exceed  $\pm 1/4$  inch of nominal dimensions. Bottom of the skinplate and the top of the skinplate on each gate section shall be straight within  $\pm 0.050$  inch over any 10 feet of length and  $\pm 0.010$  inch over any 5 feet of length.

(b) Wheels. The rolling surfaces of all wheels on each gate section or the assembled gate shall be in the same plane within  $\pm 0.010$  inch. The rolling surfaces of the wheels on each side of a gate section or the assembled gate shall be in line within  $\pm 0.005$  inch. The distance between wheels on opposite sides of a gate shall be within 0.100 inch. The rolling surface of each wheel shall be round within  $\pm 0.005$  inch and shall have no sudden steps greater than 0.001 inch.

(c) Seal Seat Bars. Seal seat bars for side seals shall be within  $1/16$  inch of a plane parallel to the rolling surface of the wheels. Seal seatbars for top seals shall not have more than 0.050 inch of camber over any ten feet of length, or 0.010 inch of camber over any five feet of length. The maximum total camber over the entire span shall not exceed 0.060 inch.

(d) Plumbness. The assembled wheel gate when hung vertically from its lifting lugs shall be plumb within  $\pm 1/4$  inch to a horizontal axis and within  $\pm 1/16$  inch to a vertical axis.

3. Embedded Parts for Wheel Gate

(a) Sealing Surfaces. Each embedded sealing surface shall be

within  $\pm 0.050$  inch of the design plane along its length and  $\pm 0.010$  inch across its width.

(b) Tracks for Wheel Gate. Upstream as well as downstream tracks for wheel gates shall be within  $\pm 0.050$  inch of the design plane along their length and  $\pm 0.005$  inch across their width. Tracks shall be checked for straightness by means of a ten foot (minimum length) straight edge and feeler gages and shall be straight within  $\pm 0.01$  inch over any 10-foot length or  $\pm 0.002$  inch over any 5-foot length. Sudden steps on track surfaces shall be not more than 0.001 inch high. Track plates shall be parallel across the opening within  $\pm 0.0050$  inch. The distance in the flow direction between the upstream and downstream track plates shall be within  $\pm 0.050$  inch.

(c) Sealing Frame

(1) Side and top seal places shall be in the same plane within  $\pm 0.050$  inch.

(2) Sill beam shall be in the design plane and within  $\pm 0.050$  inch. Centerline of the sill beam shall be perpendicular to the side and top seal plates plane within  $\pm 0.050$  inch.

(3) Length of diagonals connecting interior corners of the assembled sealing frame shall be within  $\pm 0.003$  inch for any 5 feet of seal perimeter but in no event shall exceed  $\pm 1/4$  inch of design dimensions.

(4) Guides. All guiding surfaces of each guide shall be straight within  $\pm 0.050$  inch over any 10-foot length. All guides shall be parallel with their opposite guide across the opening within  $\pm 0.125$  inch.

## 1.7 DESIGN CRITERIA

### 1.7.1 Function

All equipment and components shall be suitable for performing safely its intended functions as described in these Specifications and Contract Documents.

### 1.7.2 Features Shown on the Specification Drawings

#### 1.7.2.1 General Arrangement

The general arrangement of the equipment shall conform to the specification drawings.

#### 1.7.2.2 Mandatory Features

Mandatory features shown on the specification drawings shall be adopted without substantial change or substitution. Alternative arrangements and alternatives for mandatory features will be accepted only if in the judgement of the Contracting Officer the result is not inferior to that of the arrangement and details shown on the specification drawings. Mandatory features shall be the following dimensions, elevations, tolerances, other data or aspects:

- a. All features referring to related work, such as civil work outline and dimensions of equipment.
- b. All elevations, except if designated as "approximate" or "subject to variations".
- c. The general layout and arrangement of the equipment and its major parts, including the dimensions defining location of the equipment relative to the civil work.
- d. Dimensions, clearances, etc. designated by "maximum", "minimum" to be applied as upper or lower limit for the design.
- e. All reference to the use of a specific material or a specific group of materials.

#### 1.8 QUALITY ASSURANCE

The Contractor shall ensure that required tests, workmanship, and other performance aspects of the work comply with the applicable quality assurance requirements specified herein. In accordance with FAR 52.246-2, INSPECTION AND ACCEPTANCE, the Contractor shall provide continuous inspection of all operations for quality control and record the results for submitting to the Contracting Officer to show compliance with the Contract requirements.

#### 1.9 DELIVERY, STORAGE AND HANDLING

##### 1.9.1 Packaging

The equipment shall not be prepared for shipment until they have been inspected and accepted for shipment at origin by the Contracting Officer or his authorized representative, unless inspection has been waived in writing. Each component of equipment or subassembly shall be shipped completely assembled. The subassemblies shall be defined as the following:

1. Gate leafs.
2. Gate frames.
3. Sill beams.
4. Storage facilities.
5. Lifting of beams.

The subassemblies shall be provided with adequate protective pads, supports and blocking and shall be securely restrained to prevent distortion or damage to the painted surfaces in transit. Any loss or damage during shipment, including damage to the painted surfaces, will be considered the responsibility of the Contractor, and shall be replaced or repaired without cost to the Government. All accessories and spare parts shall be packed separately in containers plainly marked "ACCESSORIES ONLY", or "SPARE PARTS ONLY". A packing list, listing the contents of each container, shall be placed in a moisture-proof envelope and securely fastened to the outside of the container. Standard commercial packaging in accordance with ASTM D 3951 will be acceptable except where a different method or standard of packaging is specifically called for herein.

### 1.9.2 Shipping, Preservation and Storage

#### 1.9.2.1 General

Packing, crating, cradles, etc., necessary to ensure safe shipment are the responsibility of the Contractor and shall become the property of the Government upon delivery of the equipment.

Machined surfaces shall be adequately protected from corrosion and physical damage. Equipment delivered and placed in storage shall be stored with protection from the weather, humidity, temperature variation, dirt and dust, or other contaminants.

Small parts, such as bolts, anchor bolts, and other interchangeable parts which are packaged together for shipment, shall have the package labeled with the solicitation number, the part number, and the complete assembly identification.

Shipping shall be in accordance with applicable regulations and the following provisions.

#### 1.9.2.2 Preparation for Shipment

a. General. The manufacturer shall prepare, pack and load all materials and equipment for shipment in such a manner that they are protected from damage during shipment and shall be responsible for and make good any and all damage resulting from improper packing. Items subject to open storage for several months at the site shall be suitably protected from weather damage. Where necessary, heavy parts shall be mounted on skids or shall be crated and any articles or materials that might be otherwise lost shall be boxed or steel banded in bundles and plainly marked for identification. All parts exceeding 200 pounds gross weight shall be prepared for shipment so that slings for handling by crane may be readily made. All parts subject to damage from moisture shall be packed in hermetically sealed metal containers or plastic envelopes with sufficient quantities of a hygroscopic material inside or in other approved containers, within their respective packing cases, with all machined surfaces heavily coated with a rust preventing compound. Each case, crate, bundle and single items shall be marked clearly with the name of the installation for which it is intended. Each container shall be clearly marked and the contents identified for proper warehousing. All fasteners and miscellaneous plates, templates, and fixtures required for field connections, splices, alignment, etc. shall be shipped in marked boxes keyed to the erection drawings. A complete packing list shall accompany each shipment.

b. Spare Parts. All spare parts shall be packed separately in containers plainly marked "Spare Parts Only" and indicating the items of equipment to which they belong. A packing list, indicating the contents of the container, shall be securely fastened in a moistureproof envelope to the outside of each container. The packing list shall also provide the following information:

1. manufacturer,
2. contract number, and
3. identification, including manufacturer's drawing number, of each spare part in the container.

#### 1.9.2.3 Release for Shipment

No equipment shall be shipped to the site until a written release for shipment is received by the Contracting Officer.

#### 1.9.2.4 Statement of Conformance

The manufacturer shall prepare a Statement of Conformance to accompany each equipment or material shipment sent to the Site, in order to provide certification by the manufacturer that the equipment and required documentation meet all requirements of these Contract Documents. The manufacturer's representative officially responsible for assuring that all requirements of these Contract Documents are met shall sign the Statement of Conformance.

#### 1.9.2.5 Shipment

The manufacturer shall be responsible for obtaining shipping space, for insurance for the full value of the equipment until delivery at the delivery point, for freight, for securing and forwarding the shipping documents, and for the payment for all duties and shipping charges. It shall be the manufacturer's responsibility to establish the maximum shipping limitations for delivery to the delivery port.

### 1.10 PROJECT/SITE CONDITIONS

The Contractor shall visit the site to thoroughly familiarize himself with all details of the work, access, working conditions and constraints to verify dimensions in the field and he shall then advise the Contracting Officer of any discrepancies prior to performing any work. The Contractor shall be specifically responsible for the coordination and proper relation of his work to the structure and work of all trades.

### 1.11 WARRANTY

The Contractor shall guarantee all equipment for a period of 5 years from the date of acceptance. Replacement parts shall be guaranteed for 5 years from date of replacement. Warranty shall be against defective materials, design, and workmanship. In cases where the equipment manufacturer's advertised minimum guarantee is in excess of 5 years, it shall remain in force for its full period. Upon receipt of notice from the Contracting Officer of failure of any of the parts during the warranty period, new replacement parts shall be furnished and installed promptly at no additional cost to the Contracting Officer. Any operational problems shall be rectified to the satisfaction of the Contracting Officer at Contractor's expense.

#### 1.11.1 Field Wet Tests

The Contractor will be required to perform a wet tests for all gates, valves, and related equipment during the warranty period at a time determined by the Contracting Officer. The Contracting Officer shall schedule these tests after completion and acceptance of the outlet works system, and once operations allow the reservoir water level to be held close to elevation 500' or above. The Contractor shall prepare detailed procedures for the tests, and furnish all labor, materials, equipment and personnel to carry out the tests (and any needed adjustments) at no extra cost to the government.

## PART 2 PRODUCTS

## 2.1 EMERGENCY CLOSURE GATES

## 2.1.1 General

Materials and mechanical equipment shall conform to the requirements indicated on the specification drawings or referred to herein, and when not covered thereby, materials and mechanical equipment of the best commercial grade quality suited to the intended use and as approved by the Contracting Officer shall be furnished. The manufacturer's name, address, and catalog number shall be permanently displayed on a nameplate securely attached to each major item of equipment.

Where items are referred to hereinafter as "similar and equal to" a particular manufacturer's product, such references have been made merely as a convenient method of indicating the type of material or equipment required, with no intention of asserting superiority thereof. The standard product of any reputable manufacturer regularly engaged in the commercial production of the type and quality of material or equipment referred to will not be excluded on the basis of minor differences, provided essential requirements of the specifications relative to materials, capacity, and performance are met. The Contractor shall, in accordance with Paragraph: SUBMITTALS, furnish for approval, performance capacities and other pertinent information concerning the manufacturer's "equal to" standard products which he intends to incorporate in the work. "Equal to" standard products installed or used without such approval shall be at the risk of subsequent rejection.

## 2.1.2 Fixed-Wheel Emergency Closure Gates

Each gate shall be rectangular in shape. The nominal height of 19.67 feet and the nominal width of 11.0 feet represent the dimensions of the waterway immediately downstream of the gate. The gate shall be fabricated of structural steel in separable units of approximately equal height if so needed for transport. The units will be of welded construction and shall be accurately aligned with dowels and bolted together for field assembly. The mating faces of the units shall be machined so that the assembled units will not be distorted when the bolts are drawn tight. The skinplates or load-bearing plates, and the gate seals shall be on the downstream and bottom sides of the gate. The bottom of the gate must be shaped so as to avoid vibrations and minimize hydrodynamic downpull or uplift forces, in order to ensure smooth closure operation under maximum operational head. The bottom seating surface of the gate shall be normal to the longitudinal gate axis, shall be parallel to the gate sill as installed, and finished for uniform bearing on the sill.

Gate wheels shall be of stainless steel; unflanged, and rims shall be cylindrical and suitably hardened. Each wheel shall be bored for and provided with a pressed-in self-lubricating bronze bushing which will turn on an 18-8 chrome-nickel alloy steel pin and which has been eccentrically turned so that it may be rotated and secured to hold the wheel tread in a common plane with all other wheel treads. Each wheel shall be allowed a lateral float on its pin and shall be provided with self-lubricating bronze thrust washers bearing against corrosion resistant surfaces. All wheels on each side of a gate shall, when centered, lie in a common plane parallel with the longitudinal gate and side seal centerlines. Pin eccentricity and wheel float shall not be less than as shown on the approved manufacturer's shop drawings. Gate design shall be such that any wheel may be dismantled,

removed, and returned or replaced without further gate disassembly. Holes for wheel pins in supporting members of the gate shall be line bored, with all hole centerlines parallel and in a common plane.

Guide springs may be provided, if so needed, on the gate to prevent the movement or shifting of the gate by wave action or minor flow disturbances.

The guide springs shall bear against a metal guide to maintain a moderate bearing pressure between the wheels and track. The springs shall be adjustable to obtain nearly uniform bearing between the wheels and track.

Gate seals shall be of natural or synthetic rubber or neoprene with side and top seals molded into music note shapes or J-type substantially as shown on the specification drawings. Seals shall be furnished in one piece drilled and ready for installation or shall be furnished in not over eight pieces with necessary drills, cement and vulcanizing equipment for field fitting. The tensile strength of all splices shall be not less than 50 percent of the tensile strength of the unspliced material. Seals shall be so mounted that the centerlines of seal contact faces on a centered and closed gate shall coincide with the centerlines of the seal seat faces. Specially molded corner seals shall be provided for use at seal corners. Side and top seals shall be designed and assembled to tightly contact their seats normally. Side and top seals shall have sufficient strength and flexibility to project 1/4 inch beyond normal and to resist failure and extrusion, should unbalanced pressure be applied before they are opposite their seats and to return to normal setting when the pressure is equalized.

All seals shall be mounted on machined plane surfaces. They shall be secured in place by bars and fastenings of corrosion-resistant metal. Fastenings may not be in the zones of seal and seat contact.

Each completely assembled fixed-wheel gate shall close readily by gravity with at least 33 percent excess of effective weight over frictional resistances under any conditions of reservoir water level, gate opening, and flow conditions, and shall be watertight between lines of seals.

### 2.1.1.3 Gate Frames and Guides

Gate frames provided for the regulating gate intake bellmouth shall each consist of a gate sill, wheel tracks mounted on bases and seal seats mounted on frames, and all fastenings, anchor bolts, and accessories required by the design. Heavy track bases designed to withstand maximum wheel loads shall extend, as a minimum, from the sill to an elevation above the bearing points for the top gate wheel with the gate in the normal raised position. Gate frames and bases, including sills will be installed in recesses in the primary concrete. Anchor bolts, placed with this concrete, will be used for subsequent securing and alignment of the parts prior to embedment in secondary concrete. Except as noted, parts may be structural or cast steel. Seal seats and sill shall be fabricated from corrosion-resistant stainless steel plates, and may be furnished as rolled if within the specified dimensional tolerances unless specially noted and except that abutting edges shall be ground to provide continuity without offsets. Tracks and all fastenings that will not be completely embedded also shall be fabricated from materials having corrosion-resisting properties. Tracks shall have the strength and hardness required to prevent permanent deformation under maximum wheel load, shall be finished for closely fitted seating in machined recesses in the bases and shall be provided with adequate fastenings. Wheel contact surfaces may be slightly crowned to prevent edge loading, and shall be tapered at their upper ends to properly engage the wheels. Each track, with the supporting base, may be fabricated in two lengths with milled close-fitting ends above the

waterway section that provides an overlap of track on base of not less than 10 inches. Each track base shall be rigid enough to properly distribute wheel loads to the concrete of the structure under hydraulic unbalance. All embedded members shall be designed to facilitate field connection and alignment, and the filling of the formed recesses with secondary concrete. Holes shall be required in embedded frame members for reinforcing steel. Sills as installed shall be normal to the longitudinal gate axes and shall be firmly attached to the side frame members. Reinforcement bars shall be provided in the second stage concrete to withstand maximum diagonal shear stress in the concrete due to wheel loads.

Rolled steel or cast iron gate guides extending upward from the sill plates to the maintenance deck will be attached to the wheel track with adequate welding. The guides with adequate stiffening reinforcement shall be extended a short distance above El. 520.0 to provide convenient insertion of the gates whenever they are lowered by crane. Guides shall be furnished in convenient spliced lengths, and shall be of such a shape that will not be seriously affected by corrosion and can be readily handled without distortion and that, when installed, can adequately withstand any probable combination of gate and wave forces. Faces of guides shall be smooth and free of offsets, and if necessary, shall be finished to meet this requirement.

#### 2.1.4 Lifting Beam

Lifting beam shall have two hooks to engage the closure gate. The lifting beam shall be semi-automatic type of proven design. A counterweight actuated mechanism with manual lever can be used for such automatic operation. During lowering operation, the lifting beam shall automatically release the gate only after the gate rests fully on the sill under water. During raising operation, the lifting beam shall automatically grapple the closed gate under water. The lifting beam shall utilize the same gate frames and guides as provided for the emergency closure gates. All pins and axles for the hooks and guide rollers shall be of stainless steel with self lubricating bronze bushings. All fasteners used in assembling the lifting beam shall be of stainless steel. Bronze shoes are permitted on the guides as needed.

The wire ropes shall be of Type 316 stainless steel and shall have a safety factor of eight (8) based on breaking strength of rope.

Suitable lubrication provision shall be made for all hook pins and guide roller axles.

#### 2.2 SPECIAL TOOLS TO BE FURNISHED

The Contractor shall furnish all special tools required for disassembly and maintenance of the equipment. In addition, a slugging wrench shall be furnished for the gate leaf nuts and spanner wrenches as needed. A complete **list of special tools shall be furnished by Contractor.**

#### 2.3 SPARE PARTS

A set of spare parts as recommended by the manufacturer shall be supplied. All spare parts shall be duplicates of the original parts they are intended to replace. Each spare part shall bear a tag or label securely attached clearly identifying the component for which it is intended. Spare parts shall include but not be limited to:

1. One spare set of all rubber or neoprene seals and packings.
2. One spare set of used bushings.
3. One spare set of Type 316 stainless steel wire ropes.
4. Ten percent of all bolts and fasteners.
5. One spare set of storage chains and accessories.

### PART 3 EXECUTION

#### 3.1 SHOP ASSEMBLY AND TESTS

##### 3.1.1 General

1. Each gate along with wheels and seals shall be completely shop assembled. All shop assemblies and tests specified below for the various items of equipment will be witnessed by a representative of the USACOE unless specifically waived in writing. Copies of all shop inspection records shall be furnished. No equipment shall be shipped from manufacturer's shops until it has been inspected or inspection has been waived in writing by the USACOE on an item-by-item basis. Prior to major shop assemblies and tests, the manufacturer shall submit for review an outline of the procedures and tests he plans to perform to demonstrate fulfillment of the requirements of the Specifications. The shop tests shall be based on the reviewed and approved procedures.

2. While being assembled, each item of equipment shall be checked for dimensions, tolerances, accuracy of alignment workmanship and compliance to approved drawings. Any deficiencies and deviations from the contract and/or approved drawings shall be corrected. All instruments and devices required during the inspection for the examination, measurement or testing of the equipment shall be provided and calibrated by the manufacturer.

3. Before disassembling and after installation of dowels and fitted bolts between bolted subassemblies, all parts shall be clearly matchmarked. Matchmark diagrams for field erection use shall be prepared and submitted to the Engineer.

4. The direct cost of all inspection trips by the USACOE's representatives shall be borne by the Contractor. A minimum of two 5-day inspection trips shall be assumed. The cost (round-trip air fare, per diem, lodging and car rental cost) shall assume Los Angeles as the departure point and the various locations of gate equipment manufacturing as the destination. Air travel shall be business-class travel with no restrictions and shall be by the most direct route possible. The estimated per diem shall be based at a minimum, upon information from the Federal Register Chapter 301, Travel Allowances, Appendix A, or similar guidelines for selected destinations. The cost of additional trips or longer duration trips resulting from poor scheduling, lack of preparedness, unforeseen conditions or non-conformance to contract requirements shall be at no additional cost to the Government. All travel arrangements shall be made by the Contractor and included in the bid at no cost to the Government.

##### 3.1.2 Wheel Gate Embedded Parts

1. Each embedded frame, including sill beam, seal plates, track plates, bearing plates, and side members, shall be completely shop assembled and checked for correct fit and alignment. This may be done in either the vertical or horizontal position.

2. Other members of embedded parts shall be shop assembled in partial lengths successively joining their matching connections so that each field connection will be checked for assembly at least once.

### 3.1.3 Wheel Gate

1. The finished and painted wheel gate including seals, guiding devices and all other applicable accessories shall be completely shop assembled. All field splices shall be assembled; welded field-splices shall be temporarily bolted for shop assembly.

2. All seals shall be fitted to their supports during the shop assembly and proper allowances shall be made for shrinkage after aging.

3. The assembled gate shall be lifted vertically and checked for plumbness within specified tolerances. The location of the ballast to attain required plumbness and the total weight of the gate shall be noted on the shop drawings.

### 3.1.4 Gate Wheel Testing

1. General. The Contractor shall perform destructive and nondestructive testing and laboratory testing of the gate wheels as outlined below. The destructive and nondestructive tests shall be witnessed by the Contracting Officer unless waived in writing.

2. Destructive Tests (DT). One wheel shall be randomly selected for destructive testing and examination. Testing shall include complete physical and chemical analyses and macroscopic and microscopic examination of the interior wheel material including evaluation of the molecular structure grain size, inter- granular formations and precipitates and all related characteristics indicative of proper formation for the specified type material.

3. Non-Destructive Testing (NDT). Each wheel shall be 100 percent ultrasonic examined (UT) after forging:

- (a) wheel rims - crown and both sides,
- (b) wheel hubs - both sides.

Each wheel shall be 100 percent dye penetrant examined (PT) after heat treatment and after final machining.

4. Macroscopic and Microscopic Examinations. Macroscopic and microscopic examinations shall be performed on specimens removed after heat treatment from one wheel. The tests shall verify that the material structure is uniform and consistent with the type of material used for the wheels.

5. Hardness Testing. Each wheel shall be hardness tested at four random locations on each crown and on both sides of the rim. Average hardness outside the design range will be cause for rejection.

### 3.1.5 Miscellaneous Items

All other items not specifically covered above and whose testing is critical prior to shipment shall be shop tested.

## 3.2 INSPECTION AND TESTING OF PAINT

### 3.2.1 General

Paint inspection and testing shall be done as discussed in the following paragraphs.

### 3.2.2 Before and During Painting

1. Temperature and humidity during application and curing as set forth in approved application procedures.
2. Surface cleanliness and anchor profile by visual methods as set forth in approved application procedures.
3. Curing times and conditions for curing as set forth in approved application procedures.

### 3.2.3 After Painting

1. Required film thickness as set forth in approved application procedures.
2. Holiday testing by wet sponge method. Coating shall be 100 percent holiday free.
3. Non-destructive adhesion testing per ASTM D 4541. Acceptance criteria shall be as recommended by paint supplier.

## 3.3 MARKING

All parts of each closure gate assembly shall be marked and match-marked for identification to facilitate field erection and, in addition, all parts of each assembly shall be marked for ready identification with the proper assembly and to show the relative position of the part in the assembly. A diagram of such marking shall be submitted for approval. All joints shall be shop fitted and match-marked before shipping.

## 3.4 FIELD TESTING

After installation of the bulkheads, with all accessories, a test for water tightness of the system shall be made using water jets under pressure with soap bubble solution. Operating one gate at a time, each gate shall be raised to the full open position up to storage position. The gate shall then be lowered to the closed position. After the completion of this test and each gate shall be operated through four cycles in all six openings. The leaf shall travel smoothly with no tendency to chatter through the entire range of the leaf travel. Any defects and problems shall be rectified by the manufacturer to the complete satisfaction of USACOE at Contractor's expense.

## 3.5 PAINTING

The gates, frames and lifting beams including storage facilities and

accessories shall be dismantled as required and cleaned as specified on the drawings and in SECTION 09940: PAINTING HYDRAULIC STRUCTURES AND APPURTENANT WORKS before painting as follows: The non-embedded ferrous surfaces of the frames, storage facilities and air vents and the entire area of all gate leaves and lifting beams shall be painted according to paint system 4. Seals shall not be painted. The embedded surfaces of the frames shall not be painted. Stainless steel surfaces shall not be painted.

All unpainted finished surfaces exposed to the atmosphere during shipment shall be coated with a corrosion preventive compound in accordance with manufacturer's recommendations as approved by the Contracting Officer.

### 3.6 STORAGE

If the closure gates are assembled when shipped, the Contractor may store the assembled gates indoors or outdoors. The gates shall rest on timbers so that no part of the assembly is in contact with the ground. The frames, leaves, lifting beams and all accessories may be stored outdoors and shall rest on timber so that no part is in contact with the ground.

### 3.7 INSTALLATION

The gate members shall be erected in strict conformity with the match marks, taper pins and dowels used at the time of shop assembly. The parts shall be aligned with the taper pins and dowels and then bolted together. Two prints of the match marked drawings shall be shipped with the gates. The gate frames and storage latches shall be held rigidly in place, true to grade, line and height, until placing of the concrete is completed. The gate frame and seals surfaces shall be set and maintained so that no part of the sealing surfaces shall deviate from a vertical plumb plane by more than 0.010 inch provided that the deviation shall not exceed more than 0.002 inch per foot. During installation, all bolts shall be tightened by calibrated torque wrenches. The torque reading of wrenches shall be approved. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to retighten bolts which may have been loosened by the tightening of subsequent bolts, until all bolts are tightened to the prescribed amount. The outside surfaces of the gate frames, and other parts to be embedded in concrete shall be cleaned of all rust, grease and dirt before the concrete is placed. After installation, all gate frames, and similar parts shall be tested with a hammer to detect possible voids in adjacent concrete. Three-fourths-inch N.P.T. holes shall be drilled and tapped as needed if voids are detected. Voids shall be grouted and the grout holes shall be fitted with solid steel pipe plugs and ground smooth. Grouting pressures shall not exceed 50 psi. After all concreting and/or grouting operations have been completed, a survey shall be conducted to determine whether or not the above specified tolerances have been maintained. If the specified tolerances have not been maintained, such corrective action shall be taken as directed or approved by the Contracting Officer.

### 3.8 EQUIPMENT GUARANTEES

#### 3.8.1 General

All guarantees and warranties, whether express or implied, of materials, equipment, or workmanship that are in favor of the Contractor and manufacturer shall be transferred and assigned to the purchaser at the completion of installation and testing of any equipment furnished under this contract, and before final payment is made for such equipment. The

Contractor and manufacturer shall obtain the consent of any relevant manufacturer or supplier of material, equipment or workmanship to the transfer and assignment of such warranties and guarantees to the Contracting Officer. Such guarantees and warranties shall be in addition to those required of the Contractor and manufacturer by other provisions of these Contract Documents.

The Contractor and manufacturer shall, at the date of final inspection and acceptance, issue guarantees for all permanent equipment furnished by the Contractor and manufacturer under these contract Documents that they shall be free of all defects in design, workmanship and materials; that they shall meet each and every criterion and condition of these Contract documents; and that they shall perform in accordance with any and all performance guarantees, as contained in the contract documents, or as given by the Contractor and manufacturer, which guarantees shall be effective for 5 years from the date of final inspection and acceptance.

### 3.8.2 Failure to Meet Guarantees

Should any of the equipment fail to meet the guarantees or other requirements of the Contract Documents within the time covered by the guarantees, the Purchaser may direct the Contractor and manufacturer to proceed at once to make alterations or furnish new parts as may be necessary to meet the requirements. All expenses of furnishing, delivering, and installing new parts, or making alterations to existing parts, and of tests made necessary by failure of the equipment to meet the guarantees and other requirements for the Contract Document shall be borne by the Contractor and manufacturer. If, after due notice, the Contractor and manufacturer shall refuse to correct any failure of the equipment to meet the requirements of the Contract Documents during the guarantee period, the purchaser may proceed at its own expense to correct such failure and to collect from the contractor and manufacturer an amount equal to the actual expense so incurred, including overhead and all other incidental expenses. This remedy of the purchaser is in addition to any and all other remedies provided for in the Contract Documents, or as provided for by law or equity.

### 3.9 SERVICES OF ERECTION ENGINEER(S)

The emergency closure gate supplier shall be required to provide one or more competent erection engineer who shall supervise and be responsible for the correctness of the contractor's assembly procedures, method of alignment, installation of equipment and testing. When so requested, he shall also supervise and be responsible for initial starting and all subsequent operation of the equipment until the field tests are completed. The erection engineer shall instruct the Contracting Officer for a minimum of one full day, in the operation and maintenance features of the equipment. The erection engineer shall cooperate fully with the Contractor, however, the work and operation of the manufacturer's representative shall be directed by the Contracting Officer. The Contracting Officer shall be given 30 calendar days advance notice of the time when such services of the manufacturer's representative shall be needed and the Contractor shall be held responsible for any work done in the absence of the erection engineer, or work which does not conform to the instructions issued by the manufacturer, shall be corrected.

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## SECTION 15096

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## SECTION 15096

## MAINTENANCE BULKHEAD FOR LOW FLOW OUTLETS

## PART 1 GENERAL

## 1.1 GENERAL INFORMATION

This section covers all work including designing, furnishing, installing and testing one (1) 4-foot by 4-foot Maintenance Bulkhead with one lifting (pick up) beam, and two (2) sets of gate frames, guides, seal seats, storage facilities and accessories for the low flow outlets of Prado Dam Low Flow Outlets.

The bulkhead is intended to be normally stored in a suspended position above any of the two low flow outlet intakes by means of the storage facilities provided above in each intake as shown on the drawings. The bulkhead will be picked up with the help of lifting beam from the storage position by means of a mobile crane from the deck at El. 520.0 and lowered under fairly balanced water pressure conditions to shut off flow for maintenance by closing the entrance of any of the intakes as may be needed. The gate will be normally raised under fairly balanced water pressure.

The Contractor shall design all components of the gates, frames and lifting beam and accessories to safely withstand maximum forces during the bulkhead operation and shall determine the crane capacity required.

## 1.2 MANUFACTURER PREQUALIFICATION

The bulkhead, frames, lifting beam, and all other associated elements shall be the product of a manufacturer regularly engaged in the design and fabrication of water flow shut off gates of similar size and rating. The manufacturer shall submit documentation demonstrating experience in successful design, fabrication, installation and operation of comparable size bulkheads and lifting beam.

## 1.3 REFERENCES

The publications listed below form a part of this specification to the extent applicable.

1. AISC Manual for Steel Construction - Allowable Stress Design (1989).
2. USACOE Manual EM 1110-2-2105, Design of Hydraulic Steel Structures.
3. Design Guidelines for High Head Gates - ASCE Hydro Gates Task Committee (Journal of Hydraulic Division, December 1955).
4. Handbook of Applied Hydraulics, Davis and Sorensen, Third Edition (1984).

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B46.1	(1985) Surface Texture
ANSI Y14.5	(1994) Dimensioning and Tolerancing

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1998a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 276	(1998) Stainless Steel Bars and Shapes
ASTM A 564	(1995) Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes
ASTM D 395	(1989; R 1994) Rubber Property - Compression Set
ASTM D 412	(1998; Rev. A) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 413	(1982; R 1993) Rubber Property - Adhesion to Flexible Substrate
ASTM D 471	(1996) Rubber Property - Effect of Liquids
ASTM D 572	(1988; R 1994) Rubber - Deterioration by Heat and Oxygen
ASTM D 2240	(1997e1) Rubber Property - Durometer Hardness
ASTM D 3951	(1995) Practice for Commercial Packaging
ASTM D 4541	(1995) Pull-Off Strength of Coatings Using Portable Adhesion Testers

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
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## FEDERAL SPECIFICATIONS (FS)

FS RR-W-410C	(1988) Corrosion Resistant Steel For Wire Ropes
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## 1.4 SPECIFICATION DRAWINGS

The specification drawings indicate the general arrangement, clearances (necessitated by structure and other equipment), maximum overall dimensions and other suggested pertinent features. The Contractor shall be entirely

responsible for all design and shall prepare designs and shop drawings in conformity with the specifications and design and Performance Requirements included in the solicitation. The Contractor shall submit design calculations, shop drawings and catalog data for approval prior to manufacture. The dimensions of welds and other sizes or dimensions of structural members indicated on the specification drawings as minimum are intended to be minimums.

#### 1.5 DESIGN AND PERFORMANCE REQUIREMENTS

##### 1.5.1 General

The Contractor shall design in conformity with these specifications and references listed in paragraph: REFERENCES as applicable and the following design criteria.

##### 1.5.2 Design Parameters

###### 1.5.2.1 Design Data

Gate Sill Elevation	470.0
Operational Design Head	50 Feet Measured from Gate Sill
Nominal Width of Bulkhead	4 Feet 0 Inches
Nominal Height of Bulkhead	4 Feet 0 Inches
Type of Gate	Sliding Type
Type of Hoist	Mobile Crane
Hydrostatic Design Head	96 Feet from the Gate Sill

###### 1.5.2.2 Bulkhead Design

The bulkhead shall be designed to be suitable for satisfactory and reliable closure under gravity without vibrations, cavitation, oscillations or seizing or galling problems under balanced head up to a maximum of 50 feet above the gate sill. The bulkhead will be normally raised under fairly balanced pressure condition.

###### 1.5.2.3 Gate Deflection

The maximum allowable deflection of the bulkhead shall be less than 1/1,000 of the span.

###### 1.5.2.4 Loading Conditions

The equipment shall be designed to withstand stresses during static as well as operational conditions corresponding to the loading conditions as stated below:

Normal Load Condition: Hydrostatic head of 96 feet from (above) bulkhead sills

Overload Condition: Hydrostatic head of 96 feet above bulkhead sill plus the loadings included as determined for earthquake forces.

For materials and stresses not covered by USCOE Engineering Manual EM-1110-2-2105, the allowable stresses for normal loading condition shall be the normal design stresses defined above. The allowable stresses for the overload condition shall not exceed the normal design stresses by more than 33-1/3 percent or 0.75 of the yield stresses of the materials, whichever is lower.

#### 1.5.2.5 Earthquake Forces

Earthquake forces shall be accounted for in the design as determined in accordance with Section 13080 of these specifications.

#### 1.5.3 Allowable Stresses

The allowable stresses shall be as specified in EM-1110-2-2105, U.S. Army Corps of Engineers Manual for Design of Hydraulic Steel Structures. When stress conditions and materials are not covered in EM 1110-2-2105, the following shall govern:

1. For tensile and compression stresses, the smaller of the values given below shall be allowed:
  - (a) For rolled, forged or stainless steel, the tensile and compression stresses shall not exceed 40 percent of yield point or 25 percent of ultimate strength or 16,200 psi, whichever is lower.
  - (b) For rolled or forged steel bolts, the maximum tensile or compression stresses shall be limited to 25 percent of yield point or 16.5 percent of ultimate strength, whichever is lower.
  - (c) For cast steel, the maximum tensile and compression stresses shall be limited to 33 percent of yield point or 20 percent of ultimate strength, whichever is lower.
  - (d) For cast iron, the maximum tensile strength shall be not greater than 165 percent of ultimate strength.
  - (e) For brass or bronze, the maximum tensile and compressive stress shall not exceed 33 percent of yield point or 16.5 percent of ultimate strength, whichever is lower.
2. For shear, the maximum stress shall be less than 0.6 times the allowable tensile stress, except for cast iron, the permissible shear stress shall be equal to the allowable tensile stress.
3. A corrosion allowance of 1/16 inch for structural steel members subject to submergence shall be made.
4. The coefficient of friction between teflon clad rubber seal and stainless steel shall be assumed as 0.20.
5. Loads on bearing plates shall be calculated assuming uniform load distribution and with the normal or overloads loads acting on the bulkhead structure. The bearing track plate shall be mounted to the embedded backing plate by welding. The thickness of the track plate shall be adequate not only for structural strength but also to ensure that the concrete underneath can safely withstand the stresses induced. The CONTRACTOR shall submit detailed calculations to verify the stresses.

6. The allowable stresses in all anchor bolts, bearings or other standard manufactured products shall not exceed 90 percent of the values recommended in the manufacturer's catalogues. Lower allowable stresses shall be utilized wherever these are subjected to vibrations and dynamic loads.

7. Embedded parts in the concrete structure and parts bearing on the concrete structure shall be designed for water load equal to maximum design head or wind loads as applicable together with dead and live loads from the gates, in accordance with the requirements of ACI 318 and based on a concrete 28-day compressive strength of 4,000 psi. A load factor of 1.7 shall be used for all water loads, and the combined factor dead and live loads shall be multiplied by a "Hydraulic Structural Factor",  $H_f = 1.3$ , to compute the required strength,  $U$ . When loads from earthquake, overload operating forces, or wind are included,  $H_f$  shall be multiplied by 0.75.

#### 1.5.4 Operating Forces

##### 1.5.4.1 Force Components

a. General. For calculating the operating loads, either the maximum or minimum value shall be applied to each one of the force components, so that the most conservative results are obtained. It shall normally be assumed that force components act symmetrically except if the design is asymmetrical.

b. Weight. The nominal gate weight component shall include the weight of the ballast (if any), weight of all bulkhead-mounted equipment including the components connecting the bulkhead to crane, and the weight of trapped water, as applicable. The maximum weight of gate shall include weight of silt in the gate members exposed to silt accumulation.

c. Buoyancy. The nominal buoyance shall be calculated using the volume of the gate including ballast and any other gate-mounted equipment. The maximum buoyancy shall be calculated with specific gravity of water 1.1 to allow for silt.

d. Hydrostatic Effects. Nominal magnitude of hydrostatic effects shall be calculated using the design geometry of the part or detail under such effect and the applicable hydrostatic pressures. Hydrostatic loads shall be calculated with a specific weight of 62.5 pounds per cubic foot for fresh water.

e. Friction Forces.

1. General. Maximum friction forces shall be calculated using maximum normal forces and maximum friction coefficients. Minimum friction forces shall be calculated using minimum normal forces and minimum friction coefficients. A differential pressure of 5 psi shall be assumed on the bulkhead during operation to account for possible leakage through the valves.

2. Seal Friction Force. The seal friction force shall be calculated by summing the friction caused by the hydrostatic water load acting on the seal and the seal pre-compression force. The pre-compression force shall be used as given by the seal manufacturer or if such data are not available, pre-compression forces shall be determined by tests made by

the Contractor. The following seal friction coefficient shall be used, based upon conservative engineering practices.

Index	Maximum	Minimum
Rubber on steel	1.0	0.3
Rubber on corrosion-resistant steel	0.8	0.2
Fluoro-carbon on corrosion-resistant steel	0.15	0.05
Bronze on corrosion-resistant steel	0.5	0.15

3. Sliding Friction Forces. Sliding friction forces for gates and guide shoes shall be calculated using the following minimum and maximum friction coefficients:

Item	Maximum	Minimum
Corrosion-resistant steel on carbon steel, non-lubricated	0.5	0.1
Corrosion-resistant steel on corrosion-resistant steel	0.18	0.08
Corrosion-resistant steel on corrosion-resistant steel	Not Acceptable	
Bronze on corrosion-resistant steel, non-lubricated	0.4	0.1
Bronze on corrosion-resistant steel, lubricated	0.2	0.07
Self-lubricating bearing on corrosion-resistant steel	0.2	0.06

f. Guiding Device Friction. Friction forces shall be calculated using the average operating load on the guiding device and the applicable maximum and minimum friction coefficients.

g. Bottom Seal Compression Force.

1. Bottom seal compression force shall be calculated by dividing the sill reaction due to the nominal weight of the gate minus the maximum frictional forces and the buoyancy, when the gate is nearly closed, by the length of the bottom seal.

$$\text{Compression Force} = \frac{\text{Nominal Gate Weight} - \text{Maximum Frictional Forces} - \text{Buoyancy}}{\text{Bottom Seal Length in Feet}}$$

2. Bottom seal compression force shall not be less than 250 pounds per foot length of seal.

h. Loading on Guiding System.

1. General

(a) The loads specified below shall be used for designing the embedded guiding devices with their anchorage as well as gate-mounted guiding devices with their anchoring and supporting structures including all affected gate parts; they shall also be used for defining force components to be used in operating loading combinations.

(b) Loads that do not cause rotation of the gate shall be considered acting evenly distributed among all participating guiding devices of a rigid gate. Reactions to loads causing rotation in the plane of a rigid gate shall originate only at the upper guiding device on one side and at the lowest guiding device of the opposite side. Tractions causing twisting moment around a horizontal axis in the plane of a rigid gate shall originate only at the upper pair and at the lowest pair of guiding devices.

(c) Forces and reactions on each guiding device shall be considered uniformly distributed over the design contact area. Minimum engagement shall be considered for defining the design contact area.

(d) For guide rail design, the guiding device shall be considered located both at a guide rail anchorage and also in between a pair of anchorages except for loading conditions corresponding only to a definite position such as for closed or dogged gate section.

2. Loads of Static Origin.

(a) Loads caused by the geometry, eccentricity of weights and forces, and similar effects related to the arrangement of the equipment shall be determined by customary force calculations. These loads shall correspond to effects such as the following:

- (1) direction of pull outside the plan of guides and
- (2) seating plane of the closed gate off the plane of center of gravity.

(b) Other loads of static origin such as precompression of seals, reverse water loading, and similar effects shall also be considered.

3. Guiding Effort and Water Turbulence.

(a) When the gate is not submerged, the guiding effort required to counteract the tendency of gate swinging shall be considered as at least 5 percent of the weight or a surface loading of 4 pounds per square foot, whichever is higher, in either horizontal direction. The gate area to be considered in either direction shall be the projected area of the gate outline.

(b) Effects of water turbulence for all locations where the gate is partially or fully submerged shall be computed on the basis of 20 pounds per square foot differential water load acting on the projected area of the gate outline.

4. Unsymmetrical Resistance to Operation.

(a) General. Forces parallel to the bulkhead movement and horizontal forces in the plane of the gate due to rotation shall be considered in the manner listed below.

(b) Normal Blocking Load in Lowering. Bulkhead moving downward and stopped by a resistance ("blocking force") at one lower fixed

guiding device at one guide. Acting forces shall be the average acting weights of bulkhead and accessories. The acting forces will be partially balanced by the friction forces originated at the two guiding devices receiving horizontal reactions; the remainder of the acting forces shall be balanced by the "blocking force".

(c) Extraordinary Blocking Load in Lowering. This loading condition shall be determined as for the "Normal Blocking Load in Lowering", except that the maximum downward forces shall be used rather than the average acting weight.

(d) Normal Blocking Load in Raising. Bulkhead moving upward and stopped by a resistance ("blocking force") at one upper guiding device at one guide. Acting force shall be the rated pull capacity of the hoist less the weight of the gate. The acting force shall be partially balanced by the friction forces originated at the two guiding devices receiving horizontal reactions; the remainder of the acting forces shall be balanced by the "blocking force".

(e) Extraordinary Blocking Load in Raising. This loading condition shall be determined as for the "Normal Blocking Load in Raising", except that the maximum pull capacity of the hoist shall be used rather than the rated capacity.

5. Earthquake Loading. Earthquake forces shall be determined in accordance with Section 13080 of these Specifications.

6. Normal Loading Combinations. Normal loading on guiding devices shall be obtained by combining the following loads wherever applicable:

- (a) Loads of static origin.
- (b) Loads due to guiding effort.
- (c) Normal blocking loads.

7. Overload Combinations. Overload combinations on guiding devices shall be obtained by either one of the following summations of applicable loads:

- (a) Loads of static origin, loads due to guiding effort and water turbulence, and extraordinary blocking load in raising or lowering.
- (b) Loads of static origin and loads due to guiding effort.
- (c) Loads of static origin combined with earthquake loading.

#### 1.5.4.2 Combination of Force Components.

a. Force components shall be combined according to Table 1, "Force Combination Cases", to establish the required operating forces.

b. Where all force components act parallel to each other and the hoist pull, Table 1, "Force Combination Cases", shall be used directly. Where force components are not parallel to each other and to the hoist pull, the moments (around the axis of rotation) caused by the force components shall

be used.

TABLE 1  
FORCE COMBINATION CASES

Application Force Components	Force Combination Cases		
	I Safety of Closure	II Normal Pull	III Forces on Crane During Lowering Operation
Weight	+ 0.95 Nom.	+ 1.05 Max.	+ 1.05 Max.
Buoyancy	-1.05 Max.	- 0.95 Nom.	- 0.95 Nom.
Seal and Guide Friction	- 1.3 Max.	+ 1.3 Max.	- 0.8 Min.

#### 1.5.5 Materials

The following materials and material specifications shall be used. If the bidder intends to substitute any of the materials, he should clearly state so in **the shop drawing submittal** and the reasons for substitution. He shall submit the specifications for such alternative materials.

1. Leaf, frames, guides, and lifting beams shall be of structural steel conforming to ASTM A 36/A 36M.
2. Gate seal seats shall be of stainless steel conforming to ASTM A 276, Type 316.
3. Wheel Track shall be of stainless steel conforming to ASTM A 564 Type 630.
4. Guide rollers shall be of stainless steel conforming to ASTM A 564, Type 630.
5. Wheel pins shall be of stainless steel conforming to ASTM A 276, Type 316.
6. Seal fasteners shall be of stainless steel conforming to ASTM A 276, Type 316.
7. Wire ropes shall be of corrosion resistant steel conforming to FS RR-W-410C, 1WRC.
8. Wire rope fittings shall be of corrosion resistant steel components conforming to Manufacturer's Standards.
9. Lubricating fittings shall be Alemite, Type A-1188 or A-1184, as manufactured by Alemite division of Stewart Warner Corp., 1826 West Diversey Parkway, Chicago, IL 60614, or equal.
10. Grout for machinery shall be non-shrink epoxy grout.
11. Fluoro-carbon (PTFE) bushings and washers shall be "Rulon A" as manufactured by the Dixon Industries Corporation, Bristol, RI 02809, or equal.

12. High strength fiber-reinforced phenolic bearing material shall be "ORKOT TLM" as manufactured by ORKOT Engineering Plastics, 2535 Prairie Road, Unit D, Eugene, Oregon 97402, or equal. **ORKOT TLM shall not be used for sliding bearing surfaces.**

13. Neoprene seals shall be molded of neoprene compound or copolymer of butadiene and styrene or a blend of both. The compound shall contain not less than 70 percent by volume of the basic polymer, and the remainder shall consist of reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers conforming to tensile strength 3,000 psi - ASTM D 412, elongation at break 450%, water absorption by weight 5 percent - ASTM D 471, compression set 30 % of original - ASTM D 395.

14. Fluoro-carbon clad rubber seals shall be as specified above. A fluorocarbon sheath shall be bonded to the rubber on the sealing surface. The sheath shall be abrasion resistant Fluoro-Carbon Film No. 4508 as manufactured by Buckhorn, Inc., 55 West Technecenter Drive, Milford, OH 45150, or equal. The outside surface of the fluoro-carbon sheath shall be free of adhering or bonded rubber conforming to ASTM D 412, ASTM D 2240, ASTM D 471, ASTM D 395, ASTM D 572 and ASTM D 413 (friction test).

#### 1.5.6 Anchors and Alignment Provisions

The Contractor shall be responsible to design and provide adequate number of anchors welded to the gate frames. These frames, together with anchors, should be designed for external water load equal to the maximum pool pressure. External tension anchors shall transfer the water load to the concrete by compression and/or bearing and shall prevent the gate frames from collapsing inward if leakage occurs around them. The allowable tensile and bending stresses in the structural steel members and anchors shall not exceed 16,200 pounds per square inch.

The Contractor shall also provide adequate alignment anchors with turnbuckles to permit precise alignment of the gate frames. Provisions such as seats welded to frames for hydraulic jacks and other erection tackle shall be made.

#### 1.5.7 Surface Roughness and Finish

The Contractor shall indicate on his submittal drawings the surface roughness. The Contractor shall indicate on his submittal drawings the surface roughness specified by numbers in check-type marks on the surfaces, which shall be machine finished and shall conform to the surface quality specified in ANSI B46.1, entitled, "Surface Texture", published by ANSI. specified by numbers in check-type marks on the surfaces, which shall be machine finished and shall conform to the surface quality specified in ANSI B46.1, entitled, "Surface Texture", published by ANSI.

#### 1.5.8 Tests of Materials

##### 1.5.8.1 General

All materials or parts used in the equipment shall be tested, unless otherwise directed, in conformity with applicable methods prescribed by the ASTM, or such other organizations as may be specifically required, and in general accordance with the best commercial methods. When requested, tests shall be made in the presence of the Contracting Officer. Stocked material

may be used provided evidence is furnished showing that such material meets the specified requirement, in which case tests on stocked material may be waived.

#### 1.5.8.2 Test Reports

Certified material test reports shall be furnished. The test reports shall identify the component for which the material is to be used and shall contain all information necessary to verify compliance with the Specifications.

#### 1.5.9 Workmanship

##### 1.5.9.1 General

a. All work shall be performed and completed in a thorough workmanlike manner and shall follow the best modern practices in the design and manufacture of gates and hoists. All work shall be done by personnel skilled in the related professions and trades. All parts shall be made accurately to standard so as to facilitate replacement and repairs. All bolts, nuts, screws, rivets, threads, pipe, gages, gears and measurements or dimensions shown on the shop drawings approved by the Contracting Officer shall conform to the standards specified under References. Dial special gages and templates necessary for field erection of the wheel gate shall become the property of the Government.

b. Like parts and spare parts shall be interchangeable wherever possible. Machining of fits on renewable parts shall be accurate and to specified dimensions so that replacements made to the size shown on the shop drawings may be readily installed.

c. The design and fabrication of the equipment shall provide for adequate adjustment by the use of shim plates, oversized holes, or other suitable means so that there are minimal interfacing difficulties during erection.

##### 1.5.9.2 Welding

a. General. All welds shall be continuous and watertight. All welding shall be performed by the electric-arc method, by a process that excludes the atmosphere from the molten metal, and where practicable, by automatic machines. Machined surfaces of parts affected by welding shall be machined to final dimensions after welding. Machined surfaces of parts requiring stress relief shall be machined to final dimensions after the parts have been stress relieved. Localized stress relieving will not be permitted for shop welded parts.

b. Minimum Weld Requirements. All welds shall be made continuous and watertight. The minimum size of fillet welds shall be 1/4 inch measured on the leg except if otherwise specified. Welds larger than 5/16 inch shall be made in not less than 2 passes. All groove welds including butt welds shall be full penetration, welded from both sides.

c. Preparation of Base Material. Members to be joined by welding shall be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conduits. The design of welded joints and the selection of weld filler metal shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces (up to the thickness of the metal) to be welded shall be sound metal free of visible defects, such as laminations or defects caused by

cutting operations, and free from rust, oil, grease, and other foreign matters.

d. Technique of Welding. The technique of welding, the appearance and quality of the welds, and the methods used in correcting defective work shall conform to the AWS D1.1. Special care shall be taken to avoid undercuts along the seams or warping of the structure. If undercuts appear along the welds, they shall be filled using a small diameter electrode of the same composition as the original electrode after slag, if any, is removed. Continuous and uniform maintenance of preheat and interpass temperatures will be required for all welds. Local preheating shall be used only for repairs on welds. Preheat and interpass temperature shall also be as outlined in the welding procedure according to the applicable sections of AWS D1.1 or ASME Code, Division 1.

e. Welding Qualifications. The qualification of welding procedures, welders, welding operators, and tackers shall conform to standards at least equal to Section 5, "Qualification" of AWS D1.1. The Contractor shall furnish all facilities and all equipment, materials, and other articles required to conduct qualification tests of his welders and welding operators. Certificates of welders' qualifications shall be submitted when requested.

f. Weld Finish. Welds shall, in general, be treated so that they will display good appearance and a surface suitable for painting. Structural welds shall be ground and blended to avoid stress raisers. All welds which require nondestructive examinations shall be dressed by chipping and grinding as required for good interpretation by the selected weld examination methods.

g. Environmental Requirements. Recommendations of the ASME Code, Section VIII, Division 1, Paragraph UW-30, shall be observed for temperature and weather conditions for welding.

#### 1.5.9.3 Castings

a. General. Castings shall be free from injurious defects and shall be satisfactorily cleaned for their intended use. All bronze castings for bushings and bearings shall be centrifugally cast unless approved otherwise. Surfaces of castings which are not machined shall be dressed for good appearance and for painting. The location of existing defects shall be determined, and all defects which impair the strength or utility of the casting shall be removed to sound metal before repair. The structure of the castings shall be homogeneous and free from excessive nonmetallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in the casting will be cause for its rejection.

b. Repair Welding. Minor defects that shall not impair the strength or serviceability of the castings may be repaired by welding in accordance with accepted foundry practice without review by the Contracting Officer. Defects shall be considered minor when the depth of cavity properly prepared for welding is not greater than 25 percent of the actual wall thickness but in no case greater than 3/4 inch and when the area to be welded is smaller than 8 in<sup>2</sup>. However, an accumulation of minor defects which, in the opinion of the Contracting Officer, casts doubt as to the general quality of the casting shall be considered as a major defect. A complete descriptive report of major defects, supplemented with sketches, photographs, and metallurgical test reports, as the case may warrant, and

the proposed repair procedure shall be submitted for review prior to any repair of major defects. If removal of defects reduces the stress-resisting cross-section of the casting by more than 30 percent, the casting may be rejected. All castings repaired by welding of major defects after heat treatment shall be heat treated again.

#### 1.5.9.4 Nondestructive Testing

a. General. Unless otherwise indicated, all nondestructive tests shall be in accordance with the applicable sections of ASTM Volume 03.03. The shop drawings shall define the areas, extent and type of nondestructive examinations to be employed. Personnel who perform or interpret nondestructive tests shall be qualified in accordance with ASNT Recommended Practices No. SNT-TC-1A 1988 Edition # 2045, Level II or III.

b. Examination of Welds. All critical welds, including all welds on primary structural components, shall be given complete nondestructive examination by radiographic, ultrasonic, magnetic particle, or dye-penetrant methods, as applicable or specified, throughout the entire length. Full penetration welds shall be given nondestructive examination throughout their entire length by radiographic examination. Where radiographic examination is not feasible or results are likely to be doubtful, ultrasonic supplemented by magnetic particle or liquid penetrant methods shall be used. All welds (100 percent) shall be inspected visually throughout their entire length. The Contracting Officer shall have the right to request random spot-check examination of welds, including radiographic examination, as part of the equipment inspection. Examination of welds shall be in accordance with the technique and acceptance standards of Section VIII, Division 1, of the ASME Code. Ultrasonic examination shall meet the technique and acceptance standards as defined by ASME Code, Section VIII, Appendix 12. Radiographic examination shall meet the technique and acceptance standards of Paragraph UW51, Section VIII, Division 1, of the ASME Code. Magnetic particle and liquid penetrant examination shall meet the technique and acceptance standards as defined by ASME Code, Section VIII, Division 1, Appendices 6 and 8, respectively. Where stress relieving is required, nondestructive examination shall be performed after stress relieving.

#### c. Examination of Castings

1. Castings for major components shall be given a complete ultrasonic examination and a radiographic examination insofar as practicable. No casting will be accepted having defects larger than those indicated under (14.13), C.2. Repair Welding, above. Where radiographic examination is not practicable due to configuration or accessibility, other nondestructive examination, subject to the Engineer's review, may be substituted.

2. Inspection. Castings shall be inspected visually at the foundry after they are cleaned and while defects are being removed. Castings shall also be inspected after repairs and after heat treatment. Radiographic or other nondestructive tests will be required as specified and as directed when permission is granted to repair major defects. The Contracting Officer shall have the right to require nondestructive tests at the Contractor's expense to determine:

- (a) The full extent of defects.
- (b) That the area is properly prepared for welding.

(c) That the repairs are satisfactory.

d. Examination of Forgings. Major forgings shall be given ultrasonic examination with liberal overlap and other applicable nondestructive tests, to determine that they are sound. Nondestructive examination of minor forgings shall be in accordance with accepted good practice to assure their soundness. The structure of forgings shall be homogeneous and free from excessive nonmetallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a forging will be cause for its rejection.

#### 1.5.9.5 Machine Work

a. General. Sufficient machining stock shall be allowed on all parts to be machined to ensure true finished surfaces of solid material.

b. Finished Surfaces. In addition to the machined surfaces indicated on the specification drawings, all surfaces that require machining for their intended function and those surfaces that are normally machined in good shop practice shall be machined. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to insure proper operation when assembled. No machining shall be done on working surfaces of self-lubricating bushings or washers. Corrosion-resistant-steel, seal plate surfaces in contact with seals shall be thoroughly cleaned and machined to have a smooth and even surface.

c. Pins and Pin Holes. Pin holes shall be drilled smooth and straight and at right angles to the axis of the member. The drilling shall be done after the member is securely fastened in position and shall be line bored in one set-up where practicable.

d. Unfinished Surfaces. All work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined, to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown on the specification drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts may be filled in an approved manner.

e. Assembly. Before assembly, all bearing surfaces, journals and grease and oil grooves shall be carefully cleaned and lubricated with an approved oil or grease. After assembly, each lubricating system shall be filled with an approved lubricant. Self-lubricating bearings shall be treated according to the manufacturer's instructions.

#### 1.5.9.6 Tolerances

a. General. All tolerances shall be selected to correspond to the accuracy required for the proper operation of the equipment considering the nature and function of the part. Plate thicknesses shall be governed by ASTM A 6/A 6M.

b. Designations. Tolerances shown on the specification drawings and specified elsewhere in these Specifications have been designated as

follows: dimensional tolerances for cylindrical parts in the ISO system, position and form tolerances in accordance with ANSI Y14.5, and surface finish designations in accordance with ANSI B46.1. Surface finish designations are in micrometers as determined by the root-mean-square (RMS) method. The Contractor shall use these same standards for symbols and designations, or shall submit with the first review shop drawings alternative designation codes and their correspondence with the specified standards.

c. Selection

1. General. The tolerances specified in these Specifications and on the specification drawings are maximum tolerances applicable to the equipment when it is installed. Finer shop tolerances shall be established, if necessary, to meet the specified design or operational requirements or for interchangeability of spare parts. All tolerances shall be selected with due consideration to the nature and function of the parts, to the effects of cumulative tolerances and to the corresponding accuracy required to secure proper operation, but they shall not exceed the tolerances specified below.

2. Bulkhead

(a) Skinplate. Bottom and top edge of the skinplate of the bulkhead section shall be parallel within  $\pm 0.010$  inch per 5 feet of height. Length of diagonals connecting skinplate corners shall be within  $\pm 0.003$  inch for any 5 feet of skinplate perimeter but in no event shall exceed  $\pm 1/4$  inch of nominal dimensions. Bottom of the skinplate and the top of the skinplate shall be straight within  $\pm 0.050$  inch over any 10 feet of length and  $\pm 0.010$  inch over any 5 feet of length.

(b) Seal Seat Bars. Seal seat bars for side seals shall be within  $1/16$  inch of a plane parallel to the rolling surface of the wheels. Seal seat bars for top seals shall not have more than  $0.050$  inch of camber over any ten feet of length, or  $0.010$  inch of camber over any five feet of length. The maximum total camber over the entire span shall not exceed  $0.060$  inch.

(c) Plumbness. The assembled gate when hung vertically from its lifting lug (point of connection with the hoist bottom most rod extension) shall be plumb within  $\pm 1/4$  inch to a horizontal axis and within  $\pm 1/16$  inch to a vertical axis.

3. Embedded Parts

(a) Sealing Surfaces. Each embedded sealing surface shall be within  $\pm 0.050$  inch of the design plane along its length and  $\pm 0.010$  inch across its width.

(b) Tracks. Upstream as well as downstream tracks shall be within  $\pm 0.050$  inch of the design plane along their length and  $\pm 0.005$  inch across their width. Tracks shall be checked for straightness by means of a ten foot (minimum length) straight edge and feeler gages and shall be straight within  $\pm 0.01$  inch over any 10-foot length or  $\pm 0.002$  inch over any 5-foot length. Sudden steps on track surfaces shall be not more than  $0.001$  inch high. Track plates shall be parallel across the opening within  $\pm 0.0050$  inch. The distance in the flow direction between the upstream and downstream track plates shall be within  $\pm 0.050$  inch.

(c) Sealing Frame

(1) Side and top seal places shall be in the same plane within  $\pm$  0.050 inch.

(2) Sill beam shall be in the design plane and within  $\pm$  0.050 inch. Centerline of the sill beam shall be perpendicular to the side and top seal plates plane within  $\pm$  0.050 inch.

(3) Length of diagonals connecting interior corners of the assembled sealing frame shall be within  $\pm$  0.003 inch for any 5 feet of seal perimeter but in no event shall exceed  $\pm$  1/4 inch of design dimensions.

(d) Guides. All guiding surfaces of each guide shall be straight within  $\pm$  0.050 inch over any 10-foot length. All guides shall be parallel with their opposite guide across the opening within  $\pm$  0.125 inch.

## 1.6 DESIGN CRITERIA

### 1.6.1 Function

All equipment and components shall be suitable for performing safely its intended functions as described in these Specifications and Contract Documents.

### 1.6.2 Features Shown on the Plans

a. General Arrangement. The general arrangement of the equipment shall conform to the Plans.

b. Mandatory Features. Mandatory features shown on the specification drawings shall be adopted without substantial change or substitution. Alternative arrangements and alternatives for mandatory features will be accepted only if in the judgement of the Contracting Officer the result is not inferior to that of the arrangement and details shown on the specification drawings. Mandatory features shall be the following dimensions, elevations, tolerances, other data or aspects:

1. All features referring to related work, such as civil work outline and dimensions of equipment.

2. All elevations, except if designated as "approximate" or "subject to variations".

3. The general layout and arrangement of the equipment and its major parts, including the dimensions defining location of the equipment relative to the civil work.

4. Dimensions, clearances, etc. designated by "maximum", "minimum" to be applied as upper or lower limit for the design.

5. All reference to the use of a specific material or a specific group of materials.

## 1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

##### Shop Drawings; G

Shop drawings and catalog cuts for Contractor-designed details.

All drawings submitted by the Contractor shall have the Contractor's title and drawing number on each drawing. Drawings and data shall show the specifications number. All dimensions shall be in feet and inches and all wording, signs, symbols, etc. shall be in English.

Approval Drawings and Data. As soon as practicable after date of award and before proceeding with fabrication or procurement of material, the Contractor shall submit to the Contracting Officer for approval, complete sets of shop drawings, material specifications design calculations, and commercial products data. Drawings shall conform to the requirements. Any fabrication or procurement performed, or shipment made, prior to approval of the drawings and data, shall be at the Contractor's risk. The Contracting Officer shall have the right to require the Contractor to make any changes in the equipment design which the Contracting Officer determines necessary to make the equipment conform to the requirements of these specifications without additional cost to the Government. Approval by the Contracting Officer of the Contractor's drawings or data shall not be held to relieve the Contractor of any part of the Contractor's responsibility to meet all of the requirements of these specifications or of the responsibility for the correctness of the Contractor's designs and drawings.

Where approval data are required for commercial products or equipment, the Contractor shall submit complete identifying data giving the manufacturer's name, type model, size, and characteristics of the equipment. When a catalog sheet is submitted, the particular item proposed shall be underlined or marked. The data shall be comprehensive and shall fully demonstrate that all equipment provided shall meet the requirements of these specifications. One copy of the approved data will be returned to the Contractor.

#### SD-05 Design Data

##### Design Calculations; G

Together with the shop drawings, Contractor shall submit complete set of detailed design calculations for the gates, hoists, frames, bonnets and bonnet covers including all accessories and appurtenances. The calculations should be in English and shall use feet, inches and pounds. The calculations shall be self-explanatory and shall include copies of all reference materials and data.

#### SD-08 Manufacturer's Instructions

### Installation Instructions; G

The Contractor shall furnish detailed installation instructions, with sequence of installation, drawings, methods of handling and alignment procedures, installation tolerances, special tools and installation equipment needed.

### SD-10 Operation and Maintenance Data

#### Operating and Maintenance Manuals; G

Operating and maintenance manuals shall be submitted for all equipment specified in this Section. The manuals shall include complete parts identification lists and detailed instructions for the operation, lubrication and maintenance of the equipment and for ordering replacements. The manual will be subject to approval by the Contracting Officer.

## 1.8 QUALITY ASSURANCE

The Contractor shall ensure that required tests, workmanship, and other performance aspects of the work comply with the applicable quality assurance requirements specified herein. In accordance with FAR 52.246-2, INSPECTION AND ACCEPTANCE, the Contractor shall provide continuous inspection of all operations for quality control and record the results for submitting to the Contracting Officer to show compliance with the Contract requirements.

## 1.9 DELIVERY, STORAGE AND HANDLING

### 1.9.1 Packaging

The equipment shall not be prepared for shipment until they have been inspected and accepted for shipment at origin by the Contracting Officer or his authorized representative, unless inspection has been waived in writing. Each component of equipment or subassembly shall be shipped completely assembled. The subassemblies shall be defined as the following:

1. Gate leafs.
2. Gate frames.
3. Sill beams.
4. Storage facilities.
5. Lifting of beams.

The subassemblies shall be provided with adequate protective pads, supports and blocking and shall be securely restrained to prevent distortion or damage to the painted surfaces in transit. Any loss or damage during shipment, including damage to the painted surfaces, will be considered the responsibility of the Contractor, and shall be replaced or repaired without cost to the Government. All accessories and spare parts shall be packed separately in containers plainly marked "ACCESSORIES ONLY", or "SPARE PARTS ONLY". A packing list, listing the contents of each container, shall be placed in a moisture-proof envelope and securely fastened to the outside of the container. Standard commercial packaging in accordance with ASTM D 3951

will be acceptable except where a different method or standard of packaging is specifically called for herein.

#### 1.9.2 Shipping, Preservation and Storage

##### 1.9.2.1 Shipping Responsibility

Packing, crating, cradles, etc., necessary to ensure safe shipment are the responsibility of the Contractor and shall become the property of the Government upon delivery of the equipment.

##### 1.9.2.2 Protection of Machined Surfaces

Machined surfaces shall be adequately protected from corrosion and physical damage. Equipment delivered and placed in storage shall be stored with protection from the weather, humidity, temperature variation, dirt and dust, or other contaminants.

##### 1.9.2.3 Small Parts

Small parts, such as bolts, anchor bolts, and other interchangeable parts which are packaged together for shipment, shall have the package labeled with the solicitation number, the part number, and the complete assembly identification.

##### 1.9.2.4 Regulations and Provisions

Shipping shall be in accordance with applicable regulations and the following provisions.

###### a. Preparation for Shipment

1. General. The manufacturer shall prepare, pack and load all materials and equipment for shipment in such a manner that they are protected from damage during shipment and shall be responsible for and make good any and all damage resulting from improper packing. Items subject to open storage for several months at the site shall be suitably protected from weather damage. Where necessary, heavy parts shall be mounted on skids or shall be crated and any articles or materials that might be otherwise lost shall be boxed or steel banded in bundles and plainly marked for identification. All parts exceeding 200 pounds gross weight shall be prepared for shipment so that slings for handling by crane may be readily made. All parts subject to damage from moisture shall be packed in hermetically sealed metal containers or plastic envelopes with sufficient quantities of a hygroscopic material inside or in other approved containers, within their respective packing cases, with all machined surfaces heavily coated with a rust preventing compound. Each case, crate, bundle and single items shall be marked clearly with the name of the installation for which it is intended. Each container shall be clearly marked and the contents identified for proper warehousing. All fasteners and miscellaneous plates, templates, and fixtures required for field connections, splices, alignment, etc. shall be shipped in marked boxes keyed to the erection drawings. A complete packing list shall accompany each shipment.

2. Spare Parts. All spare parts shall be packed separately in containers plainly marked "Spare Parts Only" and indicating the items of equipment to which they belong. A packing list, indicating the

contents of the Spare Parts. All spare parts shall be packed separately in containers plainly marked "Spare Parts Only" and indicating the items of equipment to which they belong. A packing list, indicating the contents of the container, shall be securely fastened in a moistureproof envelope to the outside of each container. The packing list shall also provide the following information: container, shall be securely fastened in a moistureproof envelope to the outside of each container. The packing list shall also provide the following information:

- (a) Manufacturer.
- (b) Contract Number.
- (c) Identification, including manufacturer's drawing number, of each spare part in container.

b. Release for Shipment. No equipment shall be shipped to the site until a written release for shipment is received by Contracting Officer.

c. Statement of Conformance. The manufacturer shall prepare a Statement of Conformance to accompany each equipment or material shipment sent to the Site, in order to provide certification by the manufacturer that the equipment and required documentation meet all requirements of these Contract Documents. The manufacturer's representative officially responsible for assuring that all requirements of these Contract Documents are met shall sign the Statement of Conformance.

d. Shipment. The manufacturer shall be responsible for obtaining shipping space, for insurance for the full value of the equipment until delivery at the delivery point, for freight, for securing and forwarding the shipping documents, and for the payment for all duties and shipping charges. It shall be the manufacturer's responsibility to establish the maximum shipping limitations for delivery to the delivery port.

#### 1.10 PROJECT/SITE CONDITIONS

The Contractor shall visit the site to thoroughly familiarize himself with all details of the work, access, working conditions and constraints to verify dimensions in the field and he shall then advise the Contracting Officer of any discrepancies prior to performing any work. The Contractor shall be specifically responsible for the coordination and proper relation of his work to the structure and work of all trades.

##### 1.10.1 WARRANTY

All equipment shall be guaranteed for a period of 5 years from the date of acceptance. Replacement parts shall be guaranteed for 5 years from date of replacement. Warranty shall be against defective materials, design, and workmanship. In cases where the equipment manufacturer's advertised minimum guarantee is in excess of 5 years, it shall remain in force for its full period. Upon receipt of notice from the Contracting Officer of failure of any of the parts during the warranty period, new replacement parts shall be furnished and installed promptly at no additional cost to the Contracting Officer. Any operational problems shall be rectified to the satisfaction of the Contracting Officer at Contractor's expense.

##### 1.10.1.1 Field Wet Tests

The Contractor will be required to perform a wet tests for all gates, valves, and related equipment during the warranty period at a time determined by the Contracting Officer. The Contracting Officer shall schedule these tests after completion and acceptance of the outlet works system, and once operations allow the reservoir water level to be held close to elevation 500' or above. The Contractor shall prepare detailed procedures for the tests, and furnish all labor, materials, equipment and personnel to carry out the tests (and any needed adjustments) at no extra cost to the government.

## PART 2 PRODUCTS

### 2.1 MAINTENANCE BULKHEAD

#### 2.1.1 General

Materials and mechanical equipment shall conform to the requirements indicated on the drawings or referred to herein, and when not covered thereby, materials and mechanical equipment of the best commercial grade quality suited to the intended use and as approved by the Contracting Officer shall be furnished. The manufacturer's name, address, and catalog number shall be permanently displayed on a nameplate securely attached to each major item of equipment.

Where items are referred to hereinafter as "similar and equal to" a particular manufacturer's product, such references have been made merely as a convenient method of indicating the type of material or equipment required, with no intention of asserting superiority thereof. The standard product of any reputable manufacturer regularly engaged in the commercial production of the type and quality of material or equipment referred to will not be excluded on the basis of minor differences, provided essential requirements of the specifications relative to materials, capacity, and performance are met. The Contractor shall, in accordance with Paragraph: SUBMITTALS, furnish for approval, performance capacities and other pertinent information concerning the manufacturer's "equal to" standard products which he intends to incorporate in the work. "Equal to" standard products installed or used without such approval shall be at the risk of subsequent rejection.

#### 2.1.2 Bulkhead Gate

Each gate shall be rectangular in shape. The nominal height of 4.0 feet and the nominal width of 4.0 feet represent the dimensions of the waterway immediately downstream of the gate. The gate shall be fabricated of structural steel in single unit. The unit shall be of welded construction. The skinplates or load-bearing plates, and the gate seals shall be on the downstream and bottom sides of the gate. The bottom of the gate must be shaped so as to avoid vibrations and minimize hydrodynamic downpull or uplift forces, in order to ensure smooth closure operation under maximum operational head. The bottom seating surface of the gate shall be normal to the longitudinal gate axis, will be parallel to the gate sill as installed, and finished for uniform bearing thereon.

Guide springs may be provided, if so needed, on the gate to prevent the movement or shifting of the gate by wave action or minor flow disturbances. The guide springs shall bear against a metal guide to maintain a moderate bearing pressure between the seats and track. The springs shall be adjustable to obtain nearly uniform bearing between the wheels and track.

Gate seals shall be of natural or synthetic rubber or neoprene with side and top seals molded into music note shapes substantially as shown on the specification drawings. Seals shall be furnished in one piece drilled and ready for installation or shall be furnished in not over eight pieces with necessary drills, cement and vulcanizing equipment for field fitting. The tensile strength of all splices shall be not less than 50 percent of the tensile strength of the unspliced material. Seals shall be so mounted that the centerlines of seal contact faces on a centered and closed gate shall coincide with the centerlines of the seal seat faces. Specially molded corner seals shall be provided for use at seal corners. Side and top seals shall be designed and assembled to tightly contact their seats normally. Side and top seals shall have sufficient strength and flexibility to project 1/4 inch beyond normal and to resist failure and extrusion, should unbalanced pressure be applied before they are opposite their seats and to return to normal setting when the pressure is equalized. All seals shall be mounted on machined plane surfaces. They shall be secured in place by bars and fastenings of corrosion-resistant metal. Fastenings may not be in the zones of seal and seat contact.

Each completely assembled bulkhead shall close readily by gravity with at least 33 percent excess of effective weight over frictional resistances under any conditions of reservoir water level, gate opening, and leakage flow conditions, and shall be watertight between lines of seals.

#### 2.1.3 Gate Frames and Guides

Gate frames provided by the Contractor at the bulkhead intake shall each consist of a gate sill, wheel tracks mounted on bases and seal seats mounted on frames, and all fastenings, anchor bolts, and accessories required by the design. Gate frames and bases, including sills shall be installed in recesses in the primary concrete. Anchor bolts, placed with this concrete, shall be used for subsequent securing and alignment of the parts prior to embedment in secondary concrete. Except as noted, parts may be structural or cast steel. Seal seats and sill shall be fabricated from corrosion-resistant stainless steel plates, and may be furnished as rolled if within the specified dimensional tolerances unless specially noted and except that abutting edges shall be ground to provide continuity without offsets. Tracks and all fastenings that shall not be completely embedded also shall be fabricated from materials having corrosion-resisting properties. Tracks shall have the strength and hardness required to prevent permanent deformation under maximum load, shall be finished for closely fitted seating in machined recesses in the bases and shall be provided with adequate fastenings. Contact surfaces may be slightly crowned to prevent edge loading, and shall be tapered at their upper ends to properly engage the bulkhead. Each track, with the supporting base, may be fabricated in two lengths with milled close-fitting ends above the waterway section that provides an overlap of track on base of not less than 10 inches. Each track base shall be rigid enough to properly distribute loads to the concrete of the structure under hydraulic unbalance. All embedded members shall be designed to facilitate field connection and alignment, and the filling of the formed recesses with secondary concrete. Holes shall be required in embedded frame members for reinforcing steel. Sills as installed shall be normal to the longitudinal gate axes and shall be firmly attached to the side frame members. Reinforcement bars shall be provided in the second stage concrete to withstand maximum diagonal shear stress in the concrete due to maximum loads.

Rolled steel gate guides extending upward from the sill plates to the maintenance deck shall be attached to the track with adequate welding to

withstand all possible gate forces. Guides shall be furnished in convenient spliced lengths, and shall be of such a shape that shall not be seriously affected by corrosion and can be readily handled without distortion and that, when installed, can adequately withstand any probable combination of gate and wave forces. Faces of guides shall be smooth and free of offsets, and if necessary, shall be finished to meet this requirement.

#### 2.1.3.1 Lifting Beam

Lifting beam shall have two hooks to engage the bulkhead at its center. The lifting beam shall be semi-automatic type of proven design. A counterweight actuated mechanism with manual lever can be used for such automatic operation. During lowering operation, the lifting beam shall automatically release the gate only after the gate rests fully on the sill under water. During raising operation, the lifting beam shall automatically grapple the closed bulkhead under water. The lifting beam shall utilize the same gate frames and guides as provided for the maintenance bulkhead. All pins and axles for the hooks and guide rollers shall be of stainless steel with self lubricating bronze bushings. All fasteners used in assembling the lifting beam shall be of stainless steel. Bronze shoes are permitted on the guides as needed.

The wire ropes shall be of Type 316 stainless steel with a safety factor of 8 based on breaking strength of rope.

Suitable lubrication provision shall be made for all hook pins and guide roller axles.

#### 2.2 Special Tools to be Furnished

The Contractor shall furnish all special tools required for disassembly and maintenance of the equipment. In addition, a slugging wrench shall be furnished for the gate leaf nuts and spanner wrenches as needed. A complete list of special tools shall be furnished by Contractor.

#### 2.3 Spare Parts

A set of spare parts as recommended by the manufacturer shall be supplied. All spare parts shall be duplicates of the original parts they are intended to replace. Each spare part shall bear a tag or label securely attached clearly identifying the component for which it is intended. Spare parts shall include but not be limited to:

1. One spare set of all rubber or neoprene seals and packings.
2. One spare set of bushings proposed to be used.
3. One spare set of Type 316 stainless steel wire ropes.
4. Ten percent of all bolts and fasteners.
5. One spare set of storage chains and accessories.

### PART 3 EXECUTION

#### 3.1 Shop Assembly and Tests

##### 3.1.1 General

#### 3.1.1.1 Shop Assembly

The bulkhead along with lifting beam and seals shall be completely shop assembled. All shop assemblies and tests specified below for the various items of equipment will be witnessed by a representative of the Contracting Officer unless specifically waived in writing. Copies of all shop inspection records shall be furnished. No equipment shall be shipped from manufacturer's shops until it has been inspected or inspection has been waived in writing by the Contracting Officer on an item-by-item basis. Prior to major shop assemblies and tests, the manufacturer shall submit for review an outline of the procedures and tests he plans to perform to demonstrate fulfillment of the requirements of the Specifications. The shop tests shall be based on the reviewed and approved procedures.

#### 3.1.1.2 Shop Inspection

While being assembled, each item of equipment shall be checked for dimensions, tolerances, accuracy of alignment workmanship and compliance to approved drawings. Any deficiencies and deviations from the contract and/or approved drawings shall be corrected. All instruments and devices required during the inspection for the examination, measurement or testing of the equipment shall be provided and calibrated by the manufacturer.

#### 3.1.1.3 Matchmarking

Before disassembling and after installation of dowels and fitted bolts between bolted subassemblies, all parts shall be clearly matchmarked. Matchmark diagrams for field erection use shall be prepared and submitted to the Engineer.

#### 3.1.1.4 Cost of Inspection

The direct cost of all inspection trips by the Contracting Officer's representatives shall be borne by the Contractor. A minimum of two 5-day inspection trips shall be assumed. The cost (round-trip air fare, per diem, lodging and car rental cost) shall assume Los Angeles as the departure point and the various locations of gate equipment manufacturing as the destination. Air travel shall be business-class travel with no restrictions and shall be by the most direct route possible. The estimated per diem shall be based at a minimum, upon information from the Federal Register Chapter 301, Travel Allowances, Appendix A, or similar guidelines for selected destinations. The cost of additional trips or longer duration trips resulting from poor scheduling, lack of preparedness, unforeseen conditions or non-conformance to contract requirements shall be at no additional cost to the Government. All travel arrangements shall be made by the Contractor in coordination with the Contracting Officer with all costs paid directly by the Contractor.

#### 3.1.2 Embedded Parts

##### 3.1.2.1 Shop Assembly

Each embedded frame, including sill beam, seal plates, track plates, bearing plates, and side members, shall be completely shop assembled and checked for correct fit and alignment. This may be done in either the vertical or horizontal position.

##### 3.1.2.2 Field Assembly

Other members of embedded parts shall be shop assembled in partial lengths successively joining their matching connections so that each field connection will be checked for assembly at least once.

### 3.1.3 Bulkhead Gate

#### 3.1.3.1 Shop Assembly

The finished and painted bulkhead including seals, guiding devices and all other applicable accessories shall be completely shop assembled. All field splices shall be assembled; welded field-splices shall be temporarily bolted for shop assembly.

#### 3.1.3.2 Fitting of Seals

All seals shall be fitted to their supports during the shop assembly and proper allowances shall be made for shrinkage after aging.

#### 3.1.3.3 Field Quality Control

The assembled bulkhead shall be lifted vertically and checked for plumbness within specified tolerances. The location of the ballast to attain required plumbness and the total weight of the gate shall be noted on the shop drawings.

### 3.1.4 Miscellaneous Items

All other items not specifically covered above and whose testing is critical prior to shipment shall be shop tested.

## 3.2 INSPECTION AND TESTING OF PAINT

### 3.2.1 General

Paint inspection and testing shall be done as discussed in the following paragraphs.

#### 3.2.1.1 Before and During Painting

- a. Temperature and humidity during application and curing as set forth in approved application procedures.
- b. Surface cleanliness and anchor profile by visual methods as set forth in approved application procedures.
- c. Curing times and conditions for curing as set forth in approved application procedures.

#### 3.2.1.2 After Painting

- a. Required film thickness as set forth in approved application procedures.
- b. Holiday testing by wet sponge method. Coating shall be 100 percent holiday free.
- c. Non-destructive adhesion testing per ASTM D 4541. Acceptance criteria shall be as recommended by paint supplier.

### 3.3 TEST DATA

During the shop tests, all data needed for proper evaluation of the performance of the equipment shall be recorded. All test data shall be submitted for approval. If the test data do not demonstrate compliance with the specified requirements, all required remedial actions shall be performed and the necessary tests shall be repeated until complete compliance is demonstrated.

### 3.4 MARKING

All parts of each bulkhead assembly shall be marked and match-marked for identification to facilitate field erection and, in addition, all parts of each assembly shall be marked for ready identification with the proper assembly and to show the relative position of the part in the assembly. A diagram of such marking shall be submitted for approval. All joints shall be shop fitted and match-marked before shipping.

### 3.5 FIELD TESTING

After installation of the bulkhead, with all lifting beam accessories, a test for watertightness of the system shall be made using water jets under pressure with soap bubble solution. Operating in each intake at a time, the bulkhead shall be raised to the full open position up to storage position. The gate shall then be lowered to the closed position. After the completion of this test and bulkhead gate shall be operated through four cycles in both openings. The leaf shall travel smoothly with no tendency to chatter through the entire range of the leaf travel. Any defects and problems shall be rectified by the manufacturer to the complete satisfaction of USACOE at Contractor's expense.

### 3.6 PAINTING

The gates, frames and lifting beams including storage facilities and accessories shall be dismantled as required and cleaned as specified on the drawings and in SECTION 09940: PAINTING HYDRAULIC STRUCTURES AND APPURTENANT WORKS before painting as follows: The non-embedded ferrous surfaces of the frames, storage facilities and air vents and the entire area of all gate leaves and lifting beams shall be painted according to paint system 4. Seals shall not be painted. The embedded surfaces of the frames shall not be painted. Stainless steel surfaces shall not be painted.

All unpainted finished surfaces exposed to the atmosphere during shipment shall be coated with a corrosive preventive compound.

### 3.7 STORAGE

If the bulkhead is assembled when shipped, the Contractor may store the assembled gates indoors or outdoors. The gates shall rest on timbers so that no part of the assembly is in contact with the ground. The frames, leaves, lifting beams and all accessories may be stored outdoors and shall rest on timber so that no part is in contact with the ground.

### 3.8 INSTALLATION

All equipment shall be erected in strict conformity with the match marks, taper pins and dowels used at the time of shop assembly. The parts shall be aligned with the taper pins and dowels and then bolted together. Two prints of the match marked drawings shall be shipped with the equipment.

The frames and storage latches shall be held rigidly in place, true to grade, line and height, until placing of the concrete is completed. The frame and seals surfaces shall be set and maintained so that no part of the sealing surfaces shall deviate from a vertical plumb plane by more than 0.010 inch provided that the deviation shall not exceed more than 0.002 inch per foot. During installation, all bolts shall be tightened by calibrated torque wrenches. The torque reading of wrenches shall be approved. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to retighten bolts which may have been loosened by the tightening of subsequent bolts, until all bolts are tightened to the prescribed amount. The outside surfaces of the gate frames, and other parts to be embedded in concrete shall be cleaned of all rust, grease and dirt before the concrete is placed. After installation, all gate frames, and similar parts shall be tested with a hammer to detect possible voids in adjacent concrete. Three-fourths-inch N.P.T. holes shall be drilled and tapped as needed if voids are detected. Voids shall be grouted and the grout holes shall be fitted with solid steel pipe plugs and ground smooth. Grouting pressures shall not exceed 50 psi. After all concreting and/or grouting operations have been completed, a survey shall be conducted to determine whether or not the above specified tolerances have been maintained. If the specified tolerances have not been maintained, such corrective action shall be taken as directed or approved by the Contracting Officer.

### 3.9 EQUIPMENT GUARANTEES

#### 3.9.1 General

All guarantees and warranties, whether express or implied, of materials, equipment, or workmanship running in favor of the Contractor and manufacturer shall be transferred and assigned to the purchaser at the completion of installation and testing of any equipment furnished under this contract, and before final payment is made for such equipment. The Contractor and manufacturer shall obtain the consent of any relevant manufacturer or supplier of material, equipment or workmanship to the transfer and assignment of such warranties and guarantees to the Contracting Officer. Such guarantees and warranties shall be in addition to those required of the Contractor and manufacturer by other provisions of these Contract Documents.

The Contractor and manufacturer shall, at the date of final inspection and acceptance, issue guarantees for all permanent equipment furnished by the Contractor and manufacturer under these contract Documents that they shall be free of all defects in design, workmanship and materials; that they shall meet each and every criterion and condition of these Contract documents; and that they shall perform in accordance with any and all performance guarantees, as contained in the contract documents, or as given by the Contractor and manufacturer, which guarantees shall be effective for 5 years from the date of final inspection and acceptance.

#### 3.9.2 Failure to Meet Guarantees

Should any of the equipment fail to meet the guarantees or other requirements of the Contract Documents within the time covered by the guarantees, the Contracting Officer shall direct the Contractor and manufacturer to proceed at once to make alterations or furnish new parts as may be necessary to meet the requirements. All expenses of furnishing, delivering, and installing new parts, or making alterations to existing parts, and of tests made necessary by failure of the equipment to meet the

guarantees and other requirements for the Contract Document shall be borne by the Contractor and manufacturer. If, after due notice, the Contractor and manufacturer shall refuse to correct any failure of the equipment to meet the requirements of the Contract Documents during the guarantee period, the purchaser may proceed at its own expense to correct such failure and to collect from the contractor and manufacturer an amount equal to the actual expense so incurred, including overhead and all other incidental expenses. This remedy of the purchaser is in addition to any and all other remedies provided for in the Contract Documents, or as provided for by law or equity.

### 3.10 Services of Erection Engineer(s)

The bulkhead supplier shall be required to provide one or more competent erection engineer who shall supervise and be responsible for the correctness of the contractor's assembly procedures, method of alignment, installation of equipment and testing. When so requested, he shall also supervise and be responsible for initial starting and all subsequent operation of the equipment until the field tests are completed. The erection engineer shall instruct the Contracting Officer for a minimum of one full day, in the operation and maintenance features of the equipment. The erection engineer shall cooperate fully with the Contractor, however, the work and operation of the manufacturer's representative shall be directed by the Contracting Officer. The Contracting Officer shall be given 30 calendar days advance notice of the time when such services of the manufacturer's representative shall be needed and the Contractor shall be held responsible for any work done in the absence of the manufacturer's representative. Any errors in work done in the absence of the erection engineer, or work which does not conform to the instructions issued by the manufacturer, shall be corrected.

-- End of Section --

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## SECTION 15097

## REGULATING OUTLET SLIDE GATES

## PART 1 GENERAL

## 1.1 GENERAL INFORMATION

This section covers all work required for the 9-foot 9-inch by 14-foot 9-inch regulating outlet service gates, including gate frames (bodies), bonnets, bonnet covers and accessories. The hydraulic hoists and control systems are covered in SECTION 11290, HYDRAULIC POWER SYSTEMS FOR REGULATING OUTLET GATES.

## 1.2 MANUFACTURER PREQUALIFICATION

The regulating outlet service gates, frames, bonnet covers, bonnets, and all other associated elements shall be the product of a manufacturer regularly engaged in the design and fabrication of water flow regulating gates of similar size and rating. The manufacturer shall submit documentation demonstrating experience in successful design, fabrication, installation and operation of comparably sized gates.

## 1.3 REFERENCES

The publications listed below form a part of this specification to the extent applicable. The publications are referred to in the text by basic design notices only. Latest versions and revisions shall be used regardless of dates shown.

1. AISC Manual for Steel Construction - Allowable Stress Design (1989).
2. USACOE Manual EM 1110-2-2105, Design of Hydraulic Steel Structures.
3. Design Guidelines for High Head Gates - ASCE Hydro Gates Task Committee (ASCE Journal of Hydraulics Division, December 1995).
4. Handbook of Applied Hydraulics, Davis and Sorensen, Third Edition (1984).

## ACI INTERNATIONAL (ACI)

ACI 318 (1995) Building Code Requirements for Reinforced Concrete

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1997a1) Carbon Structural Steel

ASTM A 182 (1995) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High- Temperature Service

ASTM A 216	(1993) Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
ASTM A 312	(1995) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 564	(1995) Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 536	(1999e1) Ductile Iron Castings
ASTM A 789	(1995) Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM B 584	(1998a) Copper Alloy Sand Castings for General Applications
ASTM D 3951	(1995) Practice for Commercial Packaging

## CORPS OF ENGINEERS (COE)

COE EM-1110-2-2105 Design of Hydraulic Steel Structures

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Shop Drawings; G

Shop drawings and catalog cuts for Contractor-designed details.

Where approval data are required for commercial products or equipment, the Contractor shall submit complete identifying data giving the manufacturer's name, type model, size, and characteristics of the equipment. When a catalog sheet is submitted, the particular item proposed shall be underlined or marked. The data shall be comprehensive and shall fully demonstrate that all equipment provided shall meet the requirements of these specifications. One copy of the approved data will be returned to the Contractor.

## SD-05 Design Data

Design Calculations; G

Together with the shop drawings, Contractor shall submit for approval complete set of detailed design calculations for all components of the gates, hoists, frames, bonnets and bonnet covers including all accessories and appurtenances. The calculations

shall be in English and shall use feet, inches and pounds. The calculations shall be self-explanatory and shall include copies of all reference materials and data.

a. General. All drawings submitted by the Contractor shall have the Contractor's title and drawing number on each drawing. Drawings and data shall show the appropriate specifications section number. All dimensions shall be in feet and inches and all wording, signs, symbols, etc. shall be in English.

b. Approval Drawings and Data. Before proceeding with fabrication or procurement of material, the Contractor shall submit to the Contracting Officer for approval, complete sets of shop drawings, material specifications design calculations, and commercial products data. Drawings shall conform to the specification requirements. Any fabrication or procurement performed, or shipment made, prior to approval of the drawings and data, shall be at the Contractor's risk. The USACOE shall have the right to require the Contractor to make any changes in the equipment design which the USACOE determines necessary to make the equipment conform to the requirements of these specifications without additional cost to the USACOE. Approval by the USACOE or by the A/E of the Contractor's drawings or data shall not be held to relieve the Contractor of any part of the Contractor's responsibility to meet all of the requirements of these specifications or of the responsibility for the correctness of the Contractor's designs and drawings.

#### SD-08 Manufacturer's Instructions

##### Installation Instructions; G

The Contractor shall furnish detailed installation instructions, with sequence of installation, drawings, methods of handling and alignment procedures, installation tolerances, special tools and installation equipment needed.

#### SD-10 Operation and Maintenance Data

##### Operating and Maintenance Manuals; G

Operating and maintenance manuals shall be submitted for all equipment specified in this Section. The manuals shall include complete parts identification lists and detailed instructions for the operation, lubrication and maintenance of the equipment and for ordering replacements. The manual will be subject to approval by the Contracting Officer.

### 1.5 SPECIFICATION DRAWINGS

The specification drawings indicate the general arrangement, clearances (necessitated by structure and other equipment), maximum overall dimensions and other pertinent features. The Contractor shall be entirely responsible for all design and shall prepare designs and shop drawings in conformity with the specifications and design criteria included in the solicitation. The Contractor shall submit design calculations, shop drawings and catalog data for approval prior to manufacture. The details, welds and other sizes or dimensions of structural members are intended as minimum requirements

and shall be adopted by Contractor at his discretion. The Government accepts no responsibility for their design adequacy or correctness of the dimensions.

## 1.6 DESIGN AND PERFORMANCE REQUIREMENTS

### 1.6.1 General

The Contractor shall design in conformity with these specifications, references listed in paragraph: REFERENCES as applicable, and the following design criteria.

### 1.6.2 Design Parameters

1.	Gate Sill Elevation	470.0
2.	Hydrostatic Design Head	126 Feet Measured from Gate Centerline (Pool Elevation 596.0)
3.	Operational Head	96 Feet Measured from Gate Centerline (Pool El. 566.0)
4.	Nominal Gate Width	9 Feet 9 Inches
5.	Nominal Gate Height	14 Feet 9 Inches
6.	Type of Gate	Highhead Slide Type
7.	Type of Hoist	Oil Operated Hydraulic Cylinder

b. Each gate shall be designed to be suitable for satisfactory and reliable throttling service for prolonged periods in any position between fully closed and fully open positions without vibrations, cavitation, oscillations or seizing or galling problems.

c. Downpull. Downpull on the gate shall be calculated based upon Hydraulic Design Criteria, Sheets 310-2 through 320-2/3 (Revised 10/61) of the U.S. Army Corps of Engineers on the following pages or other acceptable methods based upon hydraulic model studies on similar installation.

d. Gate Deflection. The maximum allowable deflection of the gate shall be less than 1/2,500 of the span.

e. Earthquake Forces. Forces due to earthquakes shall be determined in accordance with SECTION 13080 of these specifications.

### 1.6.3 Allowable Stresses

The allowable stresses shall be as specified by COE EM-1110-2-2105, U.S. Army Corps of Engineers Manual for Design of Hydraulic Steel Structures. Where stress conditions and materials are not covered in COE EM-1110-2-2105, the following shall govern:

1. For rolled, forged or stainless steel, the tensile and compression

stresses shall not exceed 40 percent of yield point or 25 percent of ultimate strength or 16,200 psi, whichever is lower.

2. For rolled or forged steel bolts, the maximum tensile or compression stresses shall be limited to 25 percent of yield point or 16.5 percent of ultimate strength, whichever is lower.

3. For cast steel, the maximum tensile and compression stresses shall be limited to 33 percent of yield point or 20 percent of ultimate strength, whichever is lower.

4. For cast iron, the maximum tensile strength shall not be greater than 16.5 percent of ultimate strength.

5. For brass or bronze, the maximum tensile and compressive stress shall not exceed 33 percent of yield point or 16.5 percent of ultimate strength, whichever is lower.

6. For shear, the maximum stress shall be less than 0.6 times the allowable tensile stress, except for cast iron, the permissible shear stress shall be equal to the allowable tensile stress.

7. Bearing stress between leaf and bronze seats shall not exceed 1,500 pounds per square inch.

8. For design purposes, the coefficient of friction between the leaf and bronze seal seat shall be assumed as 0.60.

9. A corrosion allowance of 1/16 inch for structural steel members subject to submergence shall be made.

10. Parts of the equipment embedded in concrete structures and parts bearing on concrete shall be designed in accordance with the requirements of ACI 318 and based upon a 28-day concrete compressive strength of 4,000 psi.

#### 1.6.4 Loading Conditions

The equipment shall be designed to withstand stresses during static as well as operational conditions corresponding to the loading conditions as stated below:

Normal Load Condition: For reservoir elevation of 596.0

Overload Condition: For reservoir elevation of 596.0 plus the forces as determined for earthquake forces.

For materials and stresses not covered by USCOE Engineering Manual COE EM-1110-2-2105, the allowable stresses for normal loading condition shall be the normal design stresses defined above. The allowable stresses for the overload condition shall not exceed the normal design stresses by more than 33-1/3 percent or 0.75 of the yield stresses of the materials, whichever is lower.

#### 1.6.5 Materials

The following materials and latest versions of the material specifications shall be used. If the bidder intends to substitute any of the materials, he should clearly state so in **the shop drawing submittal** and the reasons

for substitution. He shall submit the specifications for such alternative materials.

1. Gate leaf, frames, and bonnets shall be of structural steel conforming to ASTM A 36.
2. Gate seal seats shall be of aluminum bronze with copper 85-86.5 percent, aluminum 9.5-10.5 percent, and iron 3-4 percent.
3. Stem socket shall be of cast steel conforming to ASTM A 216, Grade WCC.
4. Stem nut shall be of manganese bronze conforming to ASTM B 584, Alloy No. 862.
5. O-ring retainer shall be of cast bronze conforming to ASTM B 584, Alloy No. 93.
6. Piston stem shall be of stainless steel with ceramic coating conforming to ASTM A 564, Type 630.
7. Gate stem shall be of stainless steel conforming to ASTM A 564, Type 630.
8. Piston shall be of cast iron conforming to ASTM A 536, Grade 80-55-06.
9. Hydraulic cylinder shall be of cast steel conforming to ASTM A 216, Grade WCC steel.
10. Cylinder flanges shall be of cast steel conforming to ASTM A 216, Grade WCC steel.
11. Oil piping (1-inch diameter and larger) shall be of seamless stainless steel conforming to ASTM A 312, Grade TP 304, Schedule 80 S.
12. Pipe fittings shall be of stainless steel conforming to ASTM A 182, Grade F 304, three thousand pounds pressure class.
13. Tubing (less than 1 inch diameter) shall be of stainless steel conforming to ASTM A 789.
14. Lubricating fittings shall be alemite, Type A-1188 or A-1184, as manufactured by Alemite Division of Stewart Warner Corp., 1826 West Diversey Parkway, Chicago, IL 60614, or equal.
15. Grout for machinery shall be non-shrink epoxy grout.
16. Fluoro-carbon (PTFE) bushings and washers shall be "Rulon A" as manufactured by the Dixon Industries Corporation, Bristol, Rhode Island 02809, or equal.
17. **Bearing material shall be bronze as stated in paragraph 2.1.2**
18. Neoprene seals shall be molded of neoprene compound or copolymer of butadiene and styrene or a blend of both. The compound shall contain not less than 70 percent by volume of the basic polymer, and the remainder shall consist of reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers.

19. Fluoro-carbon clad rubber seals shall be as specified above. A fluoro-carbon sheath shall be bonded to the rubber on the sealing surface. The sheath shall abrasion resistant Fluoro-Carbon Film No. 4508 as manufactured by Buck-horn, Inc., 55 West Technecenter Drive, Milford, OH 45150, or equal. The outside surface of the fluoro-carbon sheath shall be free of adhering or bonded rubber.

20. Elastomeric sealing rings (O-rings) shall be vulcanized compound of Nitrile Butadiene Rubber, Urometer A hardness 55±5 and tensile strength 2,500 psi minimum.

21. Lubricating oil shall be ISO VG 46, Mobil D.T.E. oil medium or Shell Turbo Oil T46 or equal.

22. Hydraulic fluid shall be Mobil EAL224H or equal.

#### 1.6.6 Anchors and Alignment Provisions

The Contractor shall be responsible to design and provide adequate number of anchors welded to the gate frames and bonnets. These frames and bonnets, together with anchors, should be designed for external water load equal to the maximum pool pressure. External tension anchors shall transfer the water load to the concrete by compression and/or bearing and shall prevent the gate frames and bonnets from collapsing inward if leakage occurs around the conduit liner and bonnets. The allowable tensile and bending stresses in the structural steel members and anchors shall not exceed 16,200 pounds per square inch. The anchors shall be preferably U-shaped steel straps 1-1/2 inches wide and about 18 inches in embedded depth.

The Contractor shall be responsible to provide adequate alignment anchors with turnbuckles to permit precise alignment of the gate frames and bonnets. Provisions such as seats welded to frames for hydraulic jacks and other erection tackle shall be made.

#### 1.6.7 Surface Roughness and Finish

The Contractor shall indicate on his submittal drawings the surface roughness specified by numbers in check-type marks on the surfaces, which shall be machine finished and shall conform to the surface quality specified in ANSI B46.1, entitled, "Surface Texture", published by ANSI.

#### 1.6.8 Welding and Stress Relieving

All welding used in fabricating the cylinders, and all radiographing and stress relieving specified shall be in accordance with the "ASME Boiler and Pressure Vessel Code, Section VIII, Division 1", referred to hereafter as the ASME Code. Welding of structural steel shall be performed in accordance with the Structural Welding Code of AWS, wherein the words "Building Commissioner" shall be interpreted to mean contracting officer. Where there is a conflict between the codes and this solicitation, the latter shall govern. If materials other than the foregoing are to be welded, procedures shall follow the best modern practice.

Shielded or submerged arc welding methods shall be used, and whenever practicable, welding shall be done with automatic machines. Weld sizes and types shall conform to those specified on the drawings. Unless specifically stated otherwise, welded parts requiring machine finish shall

be completely welded and stress relieved before being finished.

All welding shall be done by code qualified welders. If, in the opinion of the contracting officer, the work of any welder appears questionable, the welder shall be required to pass an appropriate qualification test.

The cylinder, bonnet cover, bonnet and bodies shall be stress relieved by heating the entire part as a unit in a furnace in accordance with the ASME Code. The gate leaf shall be stress relieved by any commercial vibratory method equivalent to the "Formula 62" process of the Stress Relief Engineering Company of Costa Mesa, California, which results in a dimensionally stable product. Stress relieving shall be done before performing any required machine finish work.

All joints in the shell of the cylinder which will be subjected to internal pressure shall be radiographed throughout their entire length in accordance with the ASME Code. Other welds which the contracting officer deems questionable shall be checked by dye penetrant or other suitable methods to insure weld soundness. Any defective welds shall be repaired, using procedures which are acceptable to the Contracting Officer.

#### 1.7 QUALITY ASSURANCE

The Contractor shall ensure that required tests, workmanship, and other performance aspects of the work comply with the applicable quality assurance requirements specified herein. In accordance with FAR 52.246-2, INSPECTION AND ACCEPTANCE, the Contractor shall provide continuous inspection of all operations for quality control and record the results for submitting to the Contracting Officer to show compliance with the Contract requirements.

#### 1.8 DELIVERY, STORAGE AND HANDLING

##### 1.8.1 Packaging

The equipment shall not be prepared for shipment until they have been inspected and accepted for shipment at origin by the Contracting Officer or his authorized representative, unless inspection has been waived in writing. Each component of equipment or subassembly shall be shipped completely assembled. The subassemblies shall be defined as the following:

- a. Gate leaves.
- b. Upstream gate frames.
- c. Downstream gate frames.
- d. Bonnets.
- e. Bonnet covers.

The subassemblies shall be provided with adequate protective pads, supports and blocking and shall be securely restrained to prevent distortion or damage to the painted surfaces in transit. Any loss or damage during shipment, including damage to the painted surfaces, will be considered the responsibility of the Contractor, and shall be replaced or repaired without cost to the Government. All accessories and spare parts shall be packed separately in containers plainly marked "ACCESSORIES ONLY", or "SPARE PARTS ONLY". A packing list, listing the contents of each container, shall be

placed in a moisture-proof envelope and securely fastened to the outside of the container. Standard commercial packaging in accordance with ASTM D 3951 will be acceptable except where a different method or standard of packaging is specifically called for herein.

#### 1.8.2 Shipping, Preservation and Storage

Packing, crating, cradles, etc., necessary to ensure safe shipment are the responsibility of the Contractor and shall become the property of the Government upon delivery of the equipment.

Machined surfaces shall be adequately protected from corrosion and physical damage. Equipment delivered and placed in storage shall be stored with protection from the weather, humidity, temperature variation, dirt and dust, or other contaminants.

Small parts, such as bolts, anchor bolts, and other interchangeable parts which are packaged together for shipment, shall have the package labeled with the solicitation number, the part number, and the complete assembly identification.

a. Shipping shall be in accordance with the following provisions.

1. Gates and Hoists. Each outlet gate shall be disassembled in the shop so each of the following principal subassemblies can be shipped as units. Hoist and bonnet cover assembly, including the piston and piston stem, leaf with lower seals assembled, upstream and downstream bonnets with guides assembled, and upstream and downstream bodies with seats and guides assembled, if applicable. The indicator stem shall be removed and shipped separately. The piston shall be blocked against the cylinder head, and the cylinder shall be filled with hydraulic oil, both above and below the piston. About 1 quart of hydraulic oil shall then be drained from under the piston and about 1 cup from above the piston. The extending portion of the piston stem shall be wrapped with heavy protective paper or burlap and covered with wooden strips wired or banded around the circumference. The leaf shall be securely crated or boxed so that all finished surfaces are completely covered with wood. Exposed finished flange surfaces of the bodies and bonnets shall be covered with a rust-preventive compound and protected with firmly secured wooden covers. The indicator stem shall be crated carefully to prevent damage during shipment. Special care shall be used in blocking parts or shipping units to prevent damage to the metal or paint from vibration, rubbing or shifting in transit.

Three signs spaced equally around the circumference of the piston stem shall be painted on the wooden strips stating 'DO NOT USE FOR LIFTING'. A conspicuous arrow shall be painted on the cylinder of the gate hoist assembly pointing to the bonnet cover with the note "STORE WITH THIS END DOWN".

2. Liners and Bonnets. Before disassembling and with the bonnets, liners, and body joints aligned, the flanges shall be reamed for taper pins and shall be suitably match marked. Any offsets existing at the fluidway joints shall be ground flush and joined in accordance with this solicitation and drawings.

#### 1.9 PROJECT CONDITIONS

The Contractor shall visit the site to thoroughly familiarize himself with

all details of the work, access, working conditions and constraints to verify dimensions in the field and he shall then advise the Contracting Officer of any discrepancies prior to performing any work. The Contractor shall be specifically responsible for the coordination and proper relation of his work to the structure and work of all trades.

#### 1.10 WARRANTY

All equipment shall be guaranteed for a period of 5 years from the date of acceptance. Replacement parts shall be guaranteed for 5 years from date of replacement. Warranty shall be against defective materials, design, and workmanship. In cases where the equipment manufacturer's advertised minimum guarantee is in excess of 5 years, it shall remain in force for its full period. Upon receipt of notice from the Contracting Officer of failure of any of the parts during the warranty period, new replacement parts shall be furnished and installed promptly at no additional cost to the Government.

##### 1.10.1 Field Wet Tests

**The Contractor will be required to perform a wet tests for all gates, valves, and related equipment during the warranty period at a time determined by the Contracting Officer. The Contracting Officer shall schedule these tests after completion and acceptance of the outlet works system. The test shall be designed for a hydrostatic head of 50 feet. The Contractor shall prepare detailed procedures for the tests, and furnish all labor, materials, equipment and personnel to carry out the tests (and any needed adjustments) at no extra cost to the government.**

#### PART 2 PRODUCTS

##### 2.1 REGULATING OUTLET GATES

###### 2.1.1 General

Materials and mechanical equipment shall conform to the requirements indicated on the drawings or referred to herein, and when not covered thereby, materials and mechanical equipment of the best commercial grade quality suited to the intended use and as approved by the Contracting Officer shall be furnished. The manufacturer's name, address, and catalog number shall be permanently displayed on a nameplate securely attached to each major item of equipment.

Where items are referred to hereinafter as "similar and equal to" a particular manufacturer's product, such references have been made merely as a convenient method of indicating the type of material or equipment required, with no intention of asserting superiority thereof. The standard product of any reputable manufacturer regularly engaged in the commercial production of the type and quality of material or equipment referred to will not be excluded on the basis of minor differences, provided essential requirements of the specifications relative to materials, capacity, and performance are met. The Contractor shall, in accordance with Paragraph: SUBMITTALS, furnish for approval, performance capacities and other pertinent information concerning the manufacturer's "equal to" standard products which he intends to incorporate in the work. "Equal to" standard products installed or used without such approval shall be at the risk of subsequent rejection.

###### 2.1.2 Gate Frames

Each gate frame shall include upstream body or liner and downstream body or liner, which shall be of welded steel construction. Frames backing the side seats for the slide gates shall be designed to transmit the loads safely to the concrete. The gate frames shall be designed for external water load equal to the maximum pool pressure with conduit empty. External tension anchors shall be welded to the gate frame ribs to transfer the water load safely by compression and/or bearing and shall prevent the gate frames from collapsing inwards if leakage occurs around the conduit liners and bonnets.

Mating edges of joined fluidway sections shall match within one-eighth inch and shall be ground flush with an approach slope of no steeper than 1:40. The fluidway surfaces shall be free from abrupt irregularities.

All corner fillet welds in the fluidway shall be ground to a radius of 3/8-inch.

The surfaces of the fluidway shall be smooth with no pronounced offsets, waves or distortions. The flatness of the surfaces shall be such that no more than a 3/32-inch feeler can be inserted between the surface and a 3-foot straight edge held in any position.

The surfaces of welded parts shall be in alignment and all welds shall be ground flush. All weld spatter shall be removed from the fluidway.

Corner welds of gate frames shall be ground to a radius of 5/16-inch into a concave shape.

Gasket materials, bolts, and nuts shall be furnished for all flanged connections. The gate frame shall be provided with seal seats of a bearing bronze capable of withstanding a slow sliding friction with the stainless steel cladding of the gate leaves with a bearing pressure of 1,000 pounds per square inch without seizing or galling and with a maximum friction factor of 0.6. Suitable grease piping with fittings shall be provided to permit lubrication of sliding surfaces with the grease fittings being located near the bonnet covers. Suitable grease grooves shall be provided in the seal seats to distribute the grease around the full contact areas. The inner or fluidway edge of each seat shall be finished to the contour shown on the drawing. The faces of the seal seats on the downstream frame shall be smooth finished to lie in a common plane parallel with the gate centerline. When the gate leaf and frames are assembled with the leaf closed and held firmly against the seal seats, there shall be no space between the contacting gate and frame seal-seating surfaces into which 0.006-inch feeler gage can be inserted. The bottom seat shall be strong and rigid enough to sustain the full gate weight plus maximum hydraulic hoist thrust pressure.

### 2.1.3 Gate Leaves

Each gate shall be of welded-steel construction. The gate leaves shall have **Type 316L stainless** steel clad downstream faces substantially as shown on the specification drawings. The cladding shall not be less than one-eighth inch thick after machining and shall continue across the bottom seat to an extent and with an approximate contour as shown on the drawings. The clad downstream face shall be flat so as to maintain contact with the seal seats at all gate openings. Alternatively, solid stainless steel skinplates are acceptable. The seal seats shall lie in a plane surface. Lifting lugs shall be provided at the top of the gate leaf to facilitate

installation and disassembly. **The skinplate contact surfaces as well as the seal seats shall be machined to 63 microns.**

#### 2.1.4 Bonnets

The gate bonnets shall be of welded steel construction. The top 12 inches of the gate bonnet shall be designed for 54-pounds-per-square-inch-fluidway pressure and shall be bolted to a bonnet cover designed for the same pressure, combined with a maximum thrust in either direction resulting from maximum cylinder pressure. Bonnet and bonnet cover shall be capable of transmitting such hoist loads to the concrete. The bonnets and frames must be strong enough to prevent distortion during transportation and to withstand, without distortion, an external pressure of at least 10 pounds per square inch during concrete embedment.

The bonnets must also be designed for external water load equal to the maximum pool pressure with the conduit empty. Adequate number of anchors shall be welded to the bonnet ribs to transfer the external water load to concrete safely.

#### 2.1.5 Bonnet Covers

The bonnet cover shall be designed to withstand an upward pressure of water of 54 psi, in addition to the hoist loads and forces during operation of the gates resulting from maximum cylinder pressure in either direction of gate operation. Bonnet and bonnet cover shall be capable of transmitting such loads to the concrete embedment. The bonnet cover shall be bolted to the bonnet using high strength high torque bolts. Suitable V or Chevron packings shall be provided at the openings for gate stem through the bottom cylinder head and the bonnet cover. The bottom cylinder head and the bonnet cover must provide accurate axial alignment of gate and hoist when gate is contacting its seal seats.

#### 2.1.6 Seats

The seat bars fastened to gate frames shall be machined to a snug fit with their bearing seats to provide a solid backing. Slide gate leaf seats shall be aluminum bronze conforming to a chemical analysis of copper, 85-86.5 percent; aluminum 9.5- 10.5 percent; and iron of 3.0-4.0 percent. The seats shall be forged or hammered to a Brinell hardness of 180 to 200. This material has a chemical analysis similar to the commercial product "AMPCO 16 and 18" as produced by Ampco Metal Division of Ampco-Pittsburgh Corporation, Milwaukee, Wisconsin 53201, phone: (414) 645-3750. If babbitt seat recess is used, it shall be tinned before the babbitt is poured. The babbitt shall be thoroughly peened after pouring and then machined to the finish as shown on the shop drawings approved by the Contracting Officer. Alternatively, stainless steel seats for gate bottom seal is acceptable. The welds connecting the seal bars to the gate leaf and the corrosion resistant weld on the gate leaf lip shall be made after stress-relieving. **All seat surfaces shall be machined to achieve 63 microns.**

#### 2.1.7 Gate Leaf Position Indicator

##### 2.1.7.1 Mechanical Position Indicator

The mechanical position indicator gage shall be constructed of 12-gauge brass plate and shall be rigidly and securely attached to the hydraulic cylinder. The gage shall be graduated into major, minor and intermediate divisions. Major divisions shall be 1 foot apart, minor divisions shall be

one tenth of a foot apart, and intermediate divisions shall be 6 inches apart. Letters, numerals, and divisions shall be marked on the gate by cutting or etching into the gage. Letters shall be 1/2 inch high by 3/8 inch wide, numerals shall be 3/4 inch high by 5/8 inch wide. Major divisions shall be 2-1/2 inches long, minor divisions shall be 1-1/2 inches long and intermediate divisions shall be 2 inches long. All letters, numerals and divisions shall be 1/8 inch thick. Major divisions shall be marked to indicate gate opening in feet. Intermediate divisions shall be placed to indicate one half foot increments. Gages shall be black enamel on white enamel background and baked. The enamel shall conform to FS TT-E-489, Class B. The closed position of the gate shall be accurately determined and the indicator shall be so mounted that the indicator pointer reads "0" when the gate is closed. Each gage shall have "Latched" position shown above the normal raised position mark, verified to indicate that the gate is in the latched position.

#### 2.1.7.2 Remote Indicating System

In addition to the mechanical indicators, each service gate shall be equipped with a remote indicating system to be installed as specified in SECTION 16051: ELECTRICAL CONTROL SYSTEMS.

#### 2.2 SPECIAL TOOLS TO BE FURNISHED

The Contractor shall furnish all special tools required for disassembly and maintenance of the equipment. In addition, a slugging wrench shall be furnished for the gate leaf nuts and spanner wrenches for the operator piston, latch piston and latch release. The latch piston and latch release spanner wrenches shall be extended to work in the latch body. A complete list of special tools **shall be furnished by the Contractor.**

#### 2.3 SPARE PARTS

A set of spare parts as recommended by the manufacturer shall be supplied. All spare parts shall be duplicates of the original parts they are intended to replace. Each spare part shall bear a tag or label securely attached clearly identifying the component for which it is intended. Spare parts shall include as a minimum:

1. One spare set of all rubber or neoprene seals and packings.
2. One spare stem nut and stem packings.
3. One spare set of packings for bonnet cover.
4. Ten percent of all bolts and fasteners.

### PART 3 EXECUTION

#### 3.1 GATES, SEALS AND STEM ALIGNMENTS

Each seal on gate frame shall not deviate from a true pane surface by more than 0.003 inch in any 4-foot length. Clearance between the gate sealing surface and frame seals with the leaf in the closed position shall not be more than 0.006 inch. The centerline of the stem shall not deviate more than 0.020 inch from the average plane of the gate leaf seals in any 10-foot length. There shall be no binding of the gate seals when the gate is in the raised position. End guides on the gate shall be parallel to the centerline of the gate stem with an allowable tolerance of not more than

0.060 inch in any 8 feet.

### 3.2 TESTING

#### 3.2.1 Shop Assembly and Testing

##### 3.2.1.1 Assembly

Each gate shall be completely assembled in operating position in the shop for inspection and to insure that all parts fit accurately and are in proper alignment and to the tolerances specified in paragraph: GATES, SEALS AND STEM ALIGNMENTS.

##### 3.2.1.2 No-Load Raise

Gates shall first be assembled without the cylinder head. Oil shall be admitted to the underside of the piston at a maximum pressure of 125 pounds per square inch or as determined in the final design which should raise the leaf to the full open position. A higher pressure than the above would indicate undue binding and shall be cause for rejection.

##### 3.2.1.3 Piston Leakage

The pressure shall then be released and the gate leaf allowed to lower by gravity against a controlled flow from the cylinder. Refusal of the gate to lower by gravity will indicate undue binding and shall be cause for rejection. The gate shall again be raised and a test pressure of 2,000 psi shall be held on the underside of the piston for 15 minutes. **No leakage of oil across the piston seals shall be acceptable in the shop test. The cylinder manufacturer shall provide seals to satisfy this requirement in the shop as well as during the field test after installation and warranty the effective sealing for a period of five years after implementation.** Oil used for the test shall be the same as for operation.

##### 3.2.1.4 Latch Mechanism

The cylinder head shall then be installed using 8 head bolts, equally spaced. The gate hangers shall be tested by the application of 50 psi of oil on the top of the piston for 5 minutes with the latch line vented and the air vented from the head. Pressure shall then be lowered to 25 psi and the latch release line connected to a source of 1,000 psi of oil to raise the latch piston and unlatch the gate. The source of the unlatching pressure shall be an accumulator to raise the latch piston within one second and to hold the latch piston in the raised position until the latch tines are out of the latch body. The head shall then be removed and the mechanism inspected for any deformation, galling, or looseness.

##### 3.2.1.5 Gate Leakage

The regulating gate shall be bolted together with the gate frame in its normal position and leakage test performed **at the design head.** A nominal leakage of **0.1 gallons per minute per foot of sealing perimeter** shall be allowed providing the water is not jetting by the seal plates or sills.

##### 3.2.1.6 Defects

The presence of any of the malfunctions mentioned in the preceding paragraphs or defects that affect the performance of the product shall be corrected and approved prior to delivery to the job site.

### 3.2.1.7 Marking

All parts of each slide gate assembly shall be marked and match-marked for identification to facilitate field erection and, in addition, all parts of each assembly shall be marked for ready identification with the proper assembly and to show the relative position of the part in the assembly. A diagram of such marking shall be submitted for approval. All joints shall be shop fitting and match-marked before shipping.

### 3.2.2 Field Testing

These tests shall be made with a dry conduit. After installation of the gates, with all piping and controls complete, a test for tightness of the system shall be made at 1,800 psi with the entire system full of oil that has been cleaned and all trapped air bled from the system. For the test, the bypass valves shall be set at 1,800 psi and the counterbalance valves shall be set at 800 psi. The seal bars shall be coated with light grease. Operating one gate at a time, each gate shall be raised to the full open position and the pressure maintained by allowing the oil to bypass for a minimum of 15 minutes. The gate shall then be lowered to the closed position and the pressure maintained for a minimum of 5 minutes. The pumps shall be alternated for each gate test. After the completion of this test and after all leads have been made tight, each gate shall be operated through four cycles. The leaf shall travel smoothly with no tendency to chatter through the entire range of the leaf travel. Motor and interconnecting wiring shall be tested in accordance with SECTION 16415: ELECTRICAL WORK, INTERIOR. Electrical controls and indicators shall function and all valves and the entire gate system shall operate in accordance with the requirements of the specification drawings and specifications.

### 3.3 PAINTING

The slide gates shall be dismantled as required and cleaned as specified on the specification drawings and in SECTION 09940: PAINTING: HYDRAULIC STRUCTURES AND APPURTENANT WORKS before painting as follows: The non-embedded ferrous surfaces of the bonnets, air vents, frames and the inside surface of the bonnet covers and the entire area of all gate leaves shall be painted according to paint system 4. Seals shall not be painted. The embedded surfaces of the bonnets and frames shall not be painted. The outside surfaces of the bonnet covers shall be painted according to paint system 16. Stainless steel surfaces shall not be painted.

### 3.4 SHIPPING

All unpainted finished surfaces exposed to the atmosphere during shipment shall be coated with a corrosion preventive compound in accordance with the manufacturer's written recommendations and approved by the Contracting Officer. The interior surfaces of all hoist cylinders and the gate latches shall be coated with corrosion preventive compound in accordance with the manufacturer's written recommendations and approved by the Contracting Officer.

### 3.5 STORAGE

If the slide gates are assembled when shipped, the Contractor may store the assembled slide gates outdoors. The slide gates shall rest on timbers so that no part of the assembly is in contact with the ground. If the slide

gates are not assembled when shipped, the pistons, gate stems, cylinders and cylinder heads shall be stored indoors and not in contact with the earth. The frames, bonnets, leaves, and bonnet covers may be stored outdoors and shall rest on timber so that no part is in contact with the ground. All electrical and hydraulic parts, including the hydraulic piping, shall be stored in a heated warehouse. The hydraulic piping and welded piping subassemblies as supplied, with the power unit, shall have been pickled, solvent cleaned, blown out with clean dry air and plugged. Care shall be taken during handling, storage and installation to keep the pipe and tubing interiors clean. The oil reservoir shall be inspected before installation in the presence of the Contracting Officer, and cleaned if requested.

### 3.6 INSTALLATION

The gate members shall be erected in strict conformity with the match marks, taper pins and dowels used at the time of shop assembly. The parts shall be aligned with the taper pins and dowels and then bolted together. Two prints of the match marked drawings shall be shipped with the slide gates. The gate frames and bonnet frames shall be held rigidly in place, true to grade, line and height, until placing of the concrete is completed. The gate frame and bonnet seals surfaces shall be set and maintained so that no part of the sealing surfaces shall deviate from a vertical plumb plane by more than 0.010 inch provided that the deviation shall not exceed more than 0.002 inch per foot. During installation, all bolts shall be tightened by calibrated torque wrenches. The torque reading of wrenches shall be approved. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to retighten bolts which may have been loosened by the tightening of subsequent bolts, until all bolts are tightened to the prescribed amount. The outside surfaces of the gate frames, bonnets and other parts to be embedded in concrete shall be cleaned of all rust, grease and dirt before the concrete is placed. After installation, all gate frames, conduit linings and similar parts shall be tested with a hammer to detect possible voids in adjacent concrete. Three-fourths-inch NPT holes shall be drilled and tapped in the frames and similar parts if voids are detected. Voids shall be grouted and the grout holes shall be fitted with solid steel pipe plugs and ground smooth. Grouting pressures shall not exceed 50 psi. After all concreting and/or grouting operations have been completed, a survey shall be conducted to determine whether or not the above specified tolerances have been maintained. If the specified tolerances have not been maintained, such corrective action shall be taken as directed or approved by the Contracting Officer.

### 3.7 HYDRAULIC OIL CLEANING

The Contractor shall furnish an oil purifier for cleaning the hydraulic oil upon completion of the installation. The oil purifier shall be erected and operated as specified. Oil shall be taken from the sump drain, passed through the purifier and discharged back into the sump through the fill opening. The gates shall be operated to insure that all oil in the hydraulic system passes through the purifier and this process shall continue until the total sediment and water of the purified sample does not exceed 0.05 percent when tested in accordance with test method outlined by ASTM D 1796. A one-half gallon sample shall be taken and sent to an independent laboratory and tested. New purifier filters shall be furnished by the Contractor.

### 3.8 ELECTRICAL EQUIPMENT

The Contractor shall install the control stations, pump motors, remote indicators, interconnecting wiring, conduit and electrical devices as part of the slide gate installation in accordance with the applicable provisions of SECTION 16415: ELECTRICAL WORK, INTERIOR, and as shown on the contract drawings and manufacturer's approved shop drawings.

### 3.9 VALVE SETTINGS

After field tests of gates and controls are completed, the following settings shall be made for operating conditions: Pressure relief valves shall be set at 2,000 psi. Pressure switch shall be set at 1,800 psi.

### 3.10 SERVICES OF ERECTION ENGINEER(S)

The gate supplier shall be required to provide one or more competent erection engineer who shall supervise and be responsible for the correctness of the contractor's assembly procedures, method of alignment, installation of equipment and testing. When so requested, he shall also supervise and be responsible for initial starting and all subsequent operation of the equipment until the field tests are completed. The erection engineer shall instruct the Contracting Officer for a minimum of one full day, in the operation and maintenance features of the equipment. The erection engineer shall cooperate fully with the Contractor, however, the work and operation of the manufacturer's representative shall be directed by the Contracting Officer. The Contracting Officer shall be given 30 calendar days advance notice of the time when such services of the manufacturer's representative shall be needed and the Contractor shall be held responsible for any work done in the absence of the manufacturer's representative. Any errors in work done, or work which does not conform to the instructions issued by the manufacturer, shall be corrected at no cost to the Government.

-- End of Section --

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## SECTION 15099

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## SECTION 15099

## LOW FLOW OUTLET KNIFE GATE THROTTLING VALVES AND OPERATORS

## PART 1 GENERAL

## 1.1 GENERAL INFORMATION

## 1.1.1 General

The work covered in this section consists of furnishing all plant, labor, materials, and equipment; and performing all work required to design, furnish, paint, and install two (2) electric motor operated 36-inch, knife gate valves, operators, and appurtenant equipment in the low flow outlet works of Prado Dam. All work shall be in accordance with the drawings and these specifications.

## 1.1.2 Operating Conditions

The detailed requirements described herein are for throttling valves which hereinafter shall be referred to as "valves". The valves shall be bolted to flanges located in the low flow outlet pipes and shall be used to regulate the flow of water through the conduit. The primary concern in the design and operation of the valves is reliability. Each valve shall be designed and installed to operate free from injurious structural vibration at any position between fully closed and fully opened and shall have no tendency to drift either closed or open at any position. The design of each valve shall incorporate full consideration of the approach conditions as well as the total hydraulic layout for the system. The valves will be used on a near-continuous basis. The head and discharge ranges under which the valves shall operate is given below.

Maximum Static Head	126 feet
Maximum Operating Head	96 feet of water to sill
Minimum Downstream Head	0 feet of water
Normal Operating Discharge Per Each Valve	0 - 125 cubic feet per second
Maximum Operating Discharge Range for Each Valve	0 - 250 cubic feet per second
Accuracy Required for Discharge Throttling	1 percent or less

Seismic forces shall be calculated and included in the design in accordance with the requirements of Section 13080 of these specifications.

## 1.1.3 Capacity

The normal required capacity of the system of valves is 125 cubic feet per

second at 95 feet of head with the capacity to release a minimum of 1 cubic foot per second. The maximum required capacity in case of shutdown of one of the low flow outlets is 250 cubic feet per second.

#### 1.1.4 Valve Supplier Qualification

##### 1.1.4.1 General

Due to potential operational problems with knife gate valve installations, the Contractor shall use valves of appropriate design. To assure this, the Contractor is required to have the Contracting Officer approve the qualifications of the proposed valve supplier before proceeding with valve fabrication. Therefore, 60 days prior to submittal of shop drawings, a statement by the proposed valve supplier shall be submitted that the supplier's valve design is a "proven or dependable design". Specifically, the statement shall verify that the supplier has furnished valves of the similar size and design which have operated successfully under essentially similar operating conditions for a minimum of five years.

##### 1.1.4.2 Normal Flow Velocities

Normal flow velocities in valves of such "proven design" shall have equalled or exceeded those intended for the valves in this contract. The statement shall give the location, owner's name and telephone number, and rating of the valves and the years in which the valves were manufactured, installed, and successfully operated for at least two separate installations. In addition, data on the proposed valve supplier's present manufacturing and testing facilities shall be submitted; these data shall be considered in determining whether each manufacturer is qualified to perform the work. Failure of the Contractor to comply fully with these requirements, or failure of the submitted data to demonstrate to the satisfaction of the Contracting Officer, the supplier's compliance with these Specifications, shall result in disqualification of the supplier.

#### 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. The latest revisions and versions shall be followed regardless of the date shown.

##### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B2.1 (1990) Pipe Threads (Except Dry Seal) Specifications, Dimensions, and Gaging for Taper and Straight Pipe Threads

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 193 (2000) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 276 (1998) Stainless Steel Bars and Shapes

ASTM A 307 (1997) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

ASTM A 743 (1995) Corrosion-Resistant

Iron-Chromium-Nickel and Nickel-Based  
Alloy Castings for General Applications

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

## Shop Drawings; G

Drawings include catalog cuts, templates, fabrication and assembly details, and type, grade, and class of materials, as appropriate. Elements of fabricated items inadvertently omitted on specification drawings shall be detailed by the fabricator and indicated on the shop drawings. Such data shall include, but not be limited to, valve-operating curves which show discharge in cfs versus net head in feet for each valve for valve gate positions from 10 to 100 percent in 10-percent increments. Curves shall be shown on reproducible 18-inch by 24-inch graph paper.

## SD-03 Product Data

## List of Materials; G

Two copies of all purchase and mill orders, shop orders for materials, and work orders. At the time of submittal of shop drawings, a list shall be furnished designating the material to be used for each item. The purchase orders shall contain the original mill test report, the test site address, and the name of the testing agency.

## SD-05 Design Data

## Welding Procedures; G

A complete schedule of welding procedures consisting of detailed procedure specifications for each cone valve and spool piece to be welded and tables or diagrams showing the procedure to be used for each required joint.

## SD-07 Certificates

## Certificate

Results of field and factory pressure tests and operational tests shall be submitted within 7 days after completion.

## SD-10 Operation and Maintenance Data

## Operation and Maintenance Manual; G

Manuals shall be submitted which contain operating instructions, maintenance instructions, and parts catalogs for all equipment provided under this section of the specifications. Operations and

maintenance data shall be bound and labelled: "Knife Gate Valve Operation and Maintenance Data".

#### 1.4 GUARANTEE

The valves, operating mechanisms, and operators and controls furnished under this section of the specifications shall be guaranteed to be free from defects in materials, design, workmanship, installation, and operation for a period of five years from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier. Upon receipt of notice from the Contracting Officer of failure of any part of this equipment during the guarantee period, new replacement parts shall be furnished and installed promptly. Such repairs shall restore the operation of the valves and operators to their original level. The guarantee on replacement parts or equipment shall be extended for a period of one year from the date of replacement acceptance.

### PART 2 PRODUCTS

#### 2.1 KNIFE GATE VALVES

##### 2.1.1 General

Unless otherwise specified, the workmanship and materials shall conform to the applicable provisions of SECTION 05501: METALWORK FABRICATION, MACHINE WORK AND MISCELLANEOUS PROVISIONS and as specified on the specification drawings. The valves shall be installed in accordance with the critical installation dimensions shown on the manufacturer's approved drawings.

##### 2.1.2 Construction

The standard port cast body knife gate valve shall be of stainless steel 316SS construction. The stem nut shall be of 304 stainless steel. The nuts for packing gland bolting shall have a nylon insert anti-vibration feature. Chest buttons and/or centerline buttons shall be provided for low pressure sealing by holding the gate in close alignment with the seats at all gate positions. The tips of the chest and centerline button shall contain a nylon insert (PTFE) or brass insert of approved quality.

The valve shall be provided with flush parts suitable for flushing using liquid or compressed air to flush out debris collected in the bottom or chest area of the valve. There shall be at least five flush ports per knife gate valve, two in the chest and one at bottom, two each at 45 degrees from the bottom or as recommended by the manufacturer. The flush ports shall be hydrottested in the shop and filled with reuseable plugs.

The valve seats shall be of corrosion and abrasion resistant materials and shall be replaceable.

The pressure rating of the valve including bonnet materials shall be for 150 psi CWP.

Unless otherwise approved by the Contracting Officer, the following materials shall be used in the construction of knife gate valve and components.

Item	Material	Specifications
Body, Chest and Flange	Cast Stainless Steel	ASTM A 743

Item	Material	Specifications
Bonnet	Stainless Steel	Grade CF-8M Type 316 ASTM A 276
Seat	Integral	Type 316 Nitronic 60
Gate	Stainless Steel Finished 32 RMS	ASTM A 276 Type 316
Yoke	Stainless Steel	ASTM A 276 Type 316
Yoke Fasteners	Stainless Steel	
Stem	Stainless Steel	ASTM A 276 Type 316
Lubrication Fitting	Stainless Steel	
Packing	PTFE/Graphite	
Packing Follower	Stainless Steel with Stainless Steel Bolting	ASTM A 276 Type 316

The Contractor may propose alternative materials along with complete justification, specifications and data for such proposed substitutions.

#### 2.1.3 Anchor Bolts

Anchor bolts shall be in accordance with SECTION 05120: STRUCTURAL STEEL AND MISCELLANEOUS METAL.

#### 2.1.4 Concrete Anchors

Concrete anchors shall be in accordance with SECTION 05120: STRUCTURAL STEEL AND MISCELLANEOUS METAL. Where the attached or suspended equipment does not bear directly on the concrete, an OG washer or heavy steel or malleable-iron washer and nut shall be used to provide a constant loading on the anchor. Safe working loads shall be computed at 25 percent of the proof load test.

#### 2.1.5 Operating Mechanisms

The operating mechanism shall be mounted on the valve and shall apply operating forces on the valve gate at the centerline of the valve. Torque from the motor operator shall be transmitted by extended drive shafting through an oil or grease lubricated miter gear box mounted on the valve body to oil or grease lubricated worm or bevel gear boxes located on the valve body or by an approved equivalent method. Stainless steel or high tensile bronze operator screw stem with machined threads (for a close running fit in the bronze nuts) shall control the valve gate through bronze nut (with machined threads, equipped for grease lubrication) mounted on the gate flange. All gear boxes shall be adequately sealed against the ingress of water. The operator screw stem shall be adequately protected against water, dirt, and mechanical damage by steel pipe covers, fabric bellows, telescopic tubes, or a combination thereof. The supplier shall certify that the operating mechanism is of a proven design which has operated successfully in similar installations (i.e., cone valve size and operating conditions) for a period of at least 5 years, and shall give details, locations, owners' names and telephone number for at least three such installations. Drawings shall be shall be mounted. The method chosen shall enable satisfactory torque transmission from the motor operator.

#### 2.1.6 Lubrication

Stainless steel tubing of an adequate diameter and wall thickness shall be provided for the valve to facilitate convenient lubrication of such components and areas requiring lubrication. Tubing shall extend from each grease fitting and terminate at a solid, protected, and easily accessible location near each valve operator. Flexible connections shall be provided into each valve assembly. Buttonhead grease fittings (5/8 inch) shall be used.

## 2.2 MOTOR OPERATORS

### 2.2.1 General

Each valve operator shall be a sealed design suitable for submerged service and shall include an electric motor, motor winding heater, terminal blocks, reduction gearing, torque switches, enclosure heater, position transmitters and limit switches in one assembly. The motor controls and position indicators shall be located on the hydraulic equipment platform at Elevation 512.0. Motor starters will be located in the emergency motor control center in the control room at Elevation 596.0. All wiring and controls shall conform to the requirements of specification SECTION 16415: ELECTRICAL WORK, INTERIOR. The reduction gearing shall consist of helical gears of heat-treated steel and a worm of hardened alloy steel with ground and polished threads meshing with a worm gear of high tensile bronze. The gearing shall have a service rating factor of 1.50. Normal running torque of the motor operator shall be at least 1.25 times the maximum torque required to operate the valve. All reduction gearing shall run in lubricant. Anti-friction bearings shall be used throughout. Each operator shall be constructed with a built-in lost motion device which shall permit the motor to attain full speed in both directions before imparting a hammer blow to initiate motion. Each operator shall have a handwheel capable of being operated to open or close the valves in case of electric power failure. The handwheel shall automatically declutch in case the power returns to prevent injury to personnel. The maximum rimpull force required to operate the handwheel shall not exceed 60 pounds. Certification and written evidence shall be given that each motor operator is of an approved design which has operated successfully in similar installations (i.e., knife gate valve size and operating conditions) for a period of at least five years.

### 2.2.2 Electric Motors

Each motor shall be of the high torque type, totally enclosed non-ventilated, and of heavy duty construction. Insulation shall be NEMA Class F with Class B thermal overload sensors embedded in the motor windings. Each motor shall be wired for 480 volt, 3-phase power. All motor bearings shall be of the anti-friction type and shall be prelubricated. The motor shall be capable of running at full load torque which is equal to 40 percent of the rated locked rotor torque for a 15-minute duty cycle without exceeding NEMA Class B limitation. Each electric motor operator shall be sized and geared to open knife gate valve in a period of about 3 minutes against a head of 96 feet to the sill, and to close the valve in a period of about 3 minutes against a head of 96 feet above the sill. The motor enclosure shall meet NEMA 6 for submersible service.

### 2.2.3 Nameplates

Each motor and each operator shall have a standard nameplate securely affixed thereto in a conspicuous place. Care shall be taken not to paint

over or otherwise obscure the nameplate data. Nameplates shall show the manufacturer's name, the model and serial numbers, and the following information:

1. Motor Nameplate. Frame size, full load hp, rpm, voltage, cycles, amps, duty cycle, temperature rise above ambient, locked rotor torque.
2. Operator overall gear ratio, input and output torque ratings.

#### 2.2.4 Position Limit Switches

Position limit switches and the associated gearing shall be an integral part of the valve actuator. Switches shall be activated by a rotor type design. The limit switch gear mechanism shall be enclosed to prevent entrance of dirt and foreign matter. Switches shall be adjustable, allowing for trip points from fully open to fully closed positions of valve travel. They shall not be subject to breakage or slippage due to over-travel. Limit switch contacts shall be heavyduty, gold plated silver with wiping action. The actuators shall have 8 electrically separate contacts field adjustable from normally open (N/O) to normally closed (N/C) or reverse. Limit switches shall be rated 10 ampere, 120 volt A.C.

#### 2.2.5 Position Transmitter

A potentiometer displacement transducer and transmitter shall be furnished by the valve operator manufacturer which provides a precise electrical signal proportional to valve position. Output shall be a 4 to 20 mA signal with provisions for connection to the position indicating device to be installed in the gate room as well as control room. The position indicators shall be supplied and installed by the Contractor as required in SECTION 16051: CONTROL SYSTEM - LOW FLOW OUTLET THROTTLING AND SHUT-OFF VALVES.

#### 2.2.6 Heaters

Strip-type heaters for operation on 120 volts A.C. shall be rated for 240 volts A.C. and shall be provided in the actuator housing. Heaters shall be sized to maintain the respective equipment's temperature 10 degrees F above ambient temperature.

#### 2.2.7 Pushbutton Control Station

The pushbutton control station shall be furnished for direct mounting to the electric actuator. Three double "O" ring sealed pushbuttons labeled "OPEN", "CLOSED", "STOP", one selector switch labeled "LOCAL", "OFF", "REMOTE", and two indicating lamps, RED for open and GREEN for closed, shall be furnished for the pushbutton control station. A power on LED pilot light shall also be furnished on the actuator. The pushbutton station shall be suitable for weatherproof, explosion-proof, and submersible service and shall conform to the following:

1. Weatherproof - NEMA 1, 2, 3, 4, 6 and 12.
2. Explosion-proof - Certified by Factory Mutual for Class 1, Groups B, C, and D, Divisions 1 and 2.
3. Dust Ignition Proof - Class II, Groups E, F, Divisions 1 and 2.
4. Submersible - Suitable for 150-foot head of water for 24 hours.

Indicating lamps shall be high intensity LED type. The selector switch shall have a minimum of two electrical separate contacts for each position. The pushbutton and selector switch contacts shall be rated for 120-volt, 50/60 Hertz, single-phase, 10 amperes continuous current.

#### 2.2.8 Mechanical Position Indicator

A mechanical position indicator shall be furnished. The mechanical indicator shall be an easily readable pointer dial calibrated from 0 to 100 percent corresponding to 0 to 100 percent valve position. Electronic or electrical indication for this dial is not acceptable.

#### 2.2.9 Torque Switch

Each valve actuator shall be equipped with a switch that will interrupt the control circuit in both the opening and closing directions when valve torque overload occurs or when valves require torque switch setting in the closed or open position. The torque switch shall have graduated dials for both open and close directions of travel and each shall be independently adjustable, with a positive means to limit the adjustability so as to not exceed the actuator output torque capability. Mechanical torque springs for load control shall be field replaceable without need of actuator dismantling or removal of the worm assembly.

### 2.3 GASKETS AND HARDWARE

#### 2.3.1 General

All nuts, bolts, washers, gaskets and other hardware required for installation of the valves, pipe spools and accessories shall be furnished with the valves. Hardware shall be in accordance with ASTM A 307, Grade B or ASTM A 193, Grade B7, hot-dipped galvanized after fabrication. Gaskets shall be 1/8-inch cloth inserted rubber, full face.

#### 2.3.2 Knife Gate

All nuts, bolts and washers used for the fabrication of the valve and bonnet shall be corrosion resistant steel in accordance with ASTM A 193, Grade B8 (Type 304 or 316).

## PART 3 EXECUTION

### 3.1 WELDING

All welding used in manufacturing the valves shall be performed in accordance with SECTION 05501: METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS. Prior to heat treating, any defects in welds shall be repaired and re-examined. After all welding has been completed and prior to any machining, the complete welded valve body with the fixed cone and the complete welded cylinder gate shall be heat treated by heating the entire unit in a furnace in accordance with SECTION 05501: METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS. Localized stress relieving shall not be permitted. All welds shall be 100 percent magnetic-particle inspected after heat treating and after the final grinding or machining. If magnetic-particle inspection is not feasible for any welds, then those welds shall be liquid-penetrant inspected. These tests shall ensure that all welds are free from surface discontinuities and cracks. Repairs shall be made as required until all welds pass inspection.

### 3.2 THREADS

#### 3.2.1 Pipe Threads

The thread dimensions of all piping shall be in accordance with ANSI B2.1 for "Pipe Thread (Except Dryseal)".

#### 3.2.2 Other Threads

All bolts, stud machine screws, cap screws, nuts, and tapped holes shall be threaded in accordance with ANSI B1.1 for "Unified Inch Screw Threads".

### 3.3 PAINTING

After the equipment has been manufactured, all noncorrosion-resisting surfaces shall be painted with System No. 2 according to the requirements of specification SECTION 09940: PAINTING HYDRAULIC STRUCTURES AND APPURTENANT WORKS. All painted surfaces shall be protected from abrasion or other damage at all times.

### 3.4 SUPPLIER'S NAMEPLATE

A brass nameplate shall be securely attached giving the supplier's name, address, date, weight of valve, and other pertinent data on the downstream face of each valve at a location where it can be easily read.

### 3.5 TOOLS

One set of any special tools required for assembly or disassembly of any of the equipment being supplied shall be furnished on an approved tool board. The bidder shall submit a list of such tools to be furnished along with the **shop drawing submittal**.

### 3.6 SPARE PARTS

All spare parts shall be duplicates of the original parts they are intended to replace. Each spare part shall bear a tag or label securely attached clearly identifying the component for which it is intended. The following spare parts shall be furnished:

Quantity	Item
1 set, each	Valve packings, gaskets, bushings, seals
1 set, each	Seat rings
1, each type	Torque switch
2, each type	Limit switch
1, each type	Position transmitter/transducer
2, each type	Grease fitting

### 3.7 SERVICES OF ERECTING ENGINEERS

The valve supplier shall be required to provide one or more competent erecting engineers who shall supervise and be responsible for the correctness of the Contractor's assembly procedures, method of alignment, installation of equipment, and testing. When requested, the erecting engineer shall also supervise and be responsible for initial starting and all subsequent operation of the equipment until the field tests are completed. The erecting engineer shall instruct the Contracting Officer,

for a minimum of one full day, in the operation and maintenance features of the work. The services of the erecting engineers shall be furnished at no extra cost to the Government for such reasonable time as determined necessary by the Contracting Officer. The erecting engineers shall, throughout the installation and testing of the valves, comply with all accident prevention procedures as directed.

### 3.8 ELECTRICAL EQUIPMENT

All electrical devices shall be installed as part of the valves installation in accordance with the applicable provisions of SECTION 16415: ELECTRICAL WORK, INTERIOR and as shown on the specification drawings and manufacturers' approved shop drawings.

### 3.9 ACCEPTANCE TESTING

#### 3.9.1 Motor Operators and Operating Mechanisms

After the equipment is installed, the Contractor shall test, initialize, calibrate, and checkout the valve and electric operator and all associated equipment furnished under this section. The testing shall verify proper alignment of the operator by operating the valve from fully open to fully closed positions. Position limit switches shall be adjusted and tested for proper operation. The pushbutton station shall be operated to verify proper operation of all pushbuttons, lamps, and mode switch. The valve position 4-20 ma output shall be tested for proper operation and shall be calibrated for 0 to 100 percent valve opening. A calibrated test set shall be used for monitoring the valve position current. The testing will be witnessed by the Contracting Officer's representative.

If the equipment furnished under the specifications is found to be malfunctioning and is not in working order, the contractor shall be responsible for the repair, realignment, rewiring, or replacement of equipment as may be required to restore the equipment to proper operation.

#### 3.9.2 Valves

Prior to delivery, each valve shall undergo manufacturer's testing of valve operation with the operator installed and, in addition, after installation, a hydrostatic pressure of 150 feet shall be applied to each of the valves in the closed position. The pressure shall be held for 15 minutes. No part of the valves shall be permanently deformed. The pressure shall then be lowered to 96 feet and held for 15 minutes. The rate of leakage from each valve shall not exceed 0.5 gallons per minute for a 30-minute period after water up is completed. Each valve shall be operated at least twenty cycles from fully opened to fully closed. During this test, each valve shall operate satisfactorily and there shall be no evidence of galling or wear at any friction point. Each operator and operating mechanism shall also operate satisfactorily without evidence of any defect. Each valve shall pass these tests before acceptance is given.

### 3.10 QUALITY ASSURANCE

In accordance with SC-30, the materials, installation and testing shall be inspected for compliance with the contract requirements.

-- End of Section --

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## SECTION 15300

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## SECTION 15300

## PIPING SYSTEMS - GENERAL

## PART 1 GENERAL

## 1.1 GENERAL INFORMATION

This section covers all operations in connection with the installation of the mechanical piping systems.

## 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. Latest revisions and versions shall be used.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B2.1	(1990) Pipe Threads (Except Dry Seal) Specifications, Dimensions, and Gaging for Taper and Straight Pipe Threads
ANSI B16.5	(1988) Pipe Flanges and Flanged Fittings
ANSI B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B16.25	(1992) Buttwelding Ends
ANSI B31.1	(1995) Power Piping Addenda
ANSI Z49.1	(1994) Safety in Welding and Cutting

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 182	(1995) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 276	(1998) Stainless Steel Bars and Shapes
ASTM A 312	(1995) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM F 104	(1995) Nonmetallic Gasket Materials

## AMERICAN WATERWORKS ASSOCIATION (AWWA)

AWWA C206	(1997) Field Welding of Steel Water Pipe
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 Inch through 144 Inch
FEDERAL SPECIFICATIONS (FS)	
FS 0-F-506	Flux, Soldering, Paste and Liquid
FS T-0-56A	(1970) Oakum, Marine
FS FF-B-575C	(1970) Bolts, Hexagon and Square
FS FF-N-836E	(1994) Nut: Square, Hexagon, Cap, Slotted, Castle Knurled, Welding and Single Ball Seat
FS FF-S-85C	(1994) Screw, Cap, Spotted and Hexagon Head
FS FF-S-325	Shield Expansion; Nail, Expansion and Nail, Drive Screw (Devices, Anchoring, and Masonry)
FS HH-G-156E	(1993) Gasket Material, General Purposes, Rubber Sheets, Strips and Special Pieces
FS HH-P-46E	(1991) Packing, Asbestos, Sheet, Compressed
FS QQ-C-40	(1970) Caulking, Lead Wool and Lead Pig
FS QQ-S-571	Solder, Electronic
FS WW-T-799	Tube, Copper, Seamless, Water (for Use with Solder-Flared or Compression-Type Fittings)
FS WW-U-516	Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections
FS WW-U-531	Unions, Pipe, Steel or Malleable Iron: Threaded Connection, 150 lb., 250 lb., and 300 lb. WSP

## MILITARY SPECIFICATIONS (MIL)

MIL-T-27730	(Rev. A) Tape, Antiseize, Polytetrafluoroethylene, with Dispenser
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## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Piping Systems; G.

The specification drawings show the layout of piping and other work of the piping systems. The Contractor shall carefully examine the specification drawings and shall provide detailed shop drawings. Any proposed departure from the layout details shown on the specification drawings which are necessitated by field conditions or other causes shall be submitted as shop drawings.

#### SD-03 Product Data

##### Materials and Equipment; G.

Within 60 days after award of the contract and before any materials or equipment are purchased a complete list of materials and equipment to be incorporated into the work shall be submitted.

This list shall include the names and addresses of the manufacturers, the appropriate catalog cuts, their catalog numbers and trade names. The equipment list shall stipulate by drawing part numbers or by description where the items are to be used. Approval of the materials shall be based on the manufacturer's published ratings. Any materials and equipment listed which are not in accordance with the specification requirements shall be rejected.

#### SD-06 Test Reports

##### Special Quality Control for Pressure Sensing System; G

Before work is started on the pressure sensor piping, a construction sequence and quality control plan for the entire work shall be submitted. Typical items to be included in the submitted plan shall include:

1. Step-by-step construction sequence.
2. Color coding each section of tubing at a minimum of every 5 feet to assure and keep track of the sensor from each station. Each of the tubes shall have a specific color code which shall match the existing color code.
3. Method of soldering of copper tubing, and support for copper tubing during installation.
4. Method of keeping tubing free of water and debris during construction.
5. Bubble-testing with soap solution each tubing joint as specified in paragraph: INSTRUMENTATION PIPING before it is made inaccessible by further construction. Testing procedure shall include marking joints which have been tested and tagging defective joints.
6. Water pressure testing each line entirely as specified in Paragraph: PRESSURE TESTS.
7. A check-out system to assure that each step of work is approved by the Contracting Officer before proceeding.
8. Reporting each test and inspection result.

## 1.4 PIPING SYSTEMS

### 1.4.1 Work Included

The fittings, valves, equipment, and appurtenances needed to complete the systems listed below shall be furnished and installed by the Contractor:

1. Minimum Discharge Line Piping
2. Fill line for RO water conduits
3. Instrumentation Piping

### 1.4.2 Damage Repair

Damage to structures, piping, wiring, or equipment as a result of installation procedures shall be repaired by mechanics skilled in the trades involved.

### 1.4.3 Protection to Fixtures, Materials and Equipment

Pipe, valves, and equipment openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemical or mechanical injury. At the completion of all work, the fixtures, material and equipment shall be thoroughly cleaned. Any manufacturer's temporary protective coatings on the inside and outside of the pipes and tubes for the instrumentation piezometer piping system shall be removed by an approved method.

### 1.4.4 Handling of Pipe, Equipment and Materials

Prior to and during installation, the pipe, equipment, materials and accessories shall be handled in such a manner as to prevent injury in any way to these items or materials.

### 1.4.5 Workmanship

All runs of piping and outlets shall be installed as indicated on the specification drawings. All piping shall be installed as closely as possible to walls, ceilings, columns, and all other surfaces of the structure so as to occupy the minimum of space, and shall be run parallel with lines of the structure, unless otherwise distinctly shown or noted on the specification drawings. Pipe shall be cut accurately to measurements established at the structure by the Contractor, and shall be worked into place without springing or forcing. Proper allowance shall be made for expansion and contraction of the pipe, whether or not such provision is shown on the specification drawings. All valves, traps or other accessories of the systems which have to be operated or repaired in the normal operation or maintenance of the system shall be installed in an accessible place. The pipe alignment of the installations of various piping systems shall be such that there shall be no perceptible bends or kinks. The pipes shall be pitched in the direction of flow for each system or as indicated or specified. Misalignment shall be considered sufficient cause for rejection, and rework of the piping sections involved shall be repaired. All equipment furnished under this section shall be installed in accordance with the manufacturer's recommendations.

## 1.5 WARRANTY

Manufacturer's warranties or guaranties shall be furnished, on all equipment supplied under this section that normally carry a warranty or guarantee. The period of the warranty shall be at least 1 year and shall start from the date of acceptance of the equipment either for beneficial use or final acceptance, whichever is earlier and shall be against defective materials, design and workmanship. Upon receipt of notice of failure of any part or parts, they shall be replaced promptly by the Contractor with new parts.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

#### 2.1.1 General

Materials and equipment shall conform to the drawings and these specifications. Materials and equipment shall be the products of manufacturers regularly engaged in the manufacture of such products. Pressure ratings of valves and fittings specified or shown on the drawing material lists refer to class unless otherwise indicated. Materials and equipment differing in minor respects from that specified may be proposed, provided such differences are clearly stated. All like materials and equipment shall be by the same manufacturer. Any materials required which are not covered in the piping material schedule, on the specification drawings, or in these specifications shall conform to applicable Federal Specifications, grade or class as required; or the American Society for Testing Materials; or the American National Standards Institute; or American Water Works Association. In cases where material is not covered by one of the listed specification groups, the highest commercial grade of material of product available shall be furnished. Fittings, flanges, unions and valves shall be marked in accordance with a standard practice of identification of valves, fittings, flanges and unions, such as the "MSS Marking System No. SP-25". Particular attention shall be given to the marking of valves to indicate body and trim material and pressure rating.

#### 2.1.2 Bolts, Nuts, and Studs

##### 2.1.2.1 General

Unless otherwise indicated, threaded bolts, nuts, and studs shall conform to the requirements of FS FF-B-575C, type III, Grade 1. Threaded nuts for general bolting, unless otherwise indicated, shall conform to FS FF-N-836E, type II Style 11, Grade 1.

##### 2.1.2.2 Corrosion-Resisting Steel for Fasteners

Corrosion-resisting steel for capscrews, bolts, and nuts shall be as called for on the drawings or shall conform to ASTM A 276. Lock washers specified as corrosion resisting steel shall be corrosion-resisting steel of good commercial grade.

##### 2.1.2.3 Capscrews

Unless otherwise indicated or specified, cap screws shall conform to the requirement of FS FF-S-85C, type, style, and grade as required.

##### 2.1.2.4 Anchor Bolts

Anchor bolts shall be in accordance with SECTION 05120: STRUCTURAL STEEL AND MISCELLANEOUS METAL.

#### 2.1.2.5 Concrete Anchors

Concrete anchors for piping work shall conform to the requirements of FS FF-S-325, Group II, Type 4; Group III, Type 1; or Group VIII, Type 1 or 2. The anchors shall be sized for the nominal bolt size of the device being attached or suspended. Where the attached or suspended equipment does not bear directly on the concrete, an OG washer or heavy steel or malleable-iron washer and nut shall be used to provide a constant loading on the anchor. Safe working loads shall be computed at 25 percent of the proof load test.

#### 2.1.3 Pipe Joint Material

##### 2.1.3.1 Caulking Lead

Lead shall meet the requirements of FS QQ-C-40, Type I, Grade AA.

##### 2.1.3.2 Neoprene Gaskets

Neoprene gaskets for cast-iron soil pipe shall meet the applicable requirements of ASTM C 564 and shall be a double seal, molded compression type.

##### 2.1.3.3 Oakum

Oakum shall meet the requirements of FS T-0-56A, class as required.

##### 2.1.3.4 Tape for Threaded Pipe Joints

Tape shall meet the requirements of MIL-T-27730.

#### 2.1.4 Gaskets

Gasket material shall meet the requirements of the following listed specifications as applicable; FS HH-P-46E, or ASTM F 104 (Material Identification P-1161A).

#### 2.1.5 Rubber Sheet Gaskets

Rubber sheet for use as gaskets shall meet the requirements of FS HH-G-156E, except as otherwise provided.

#### 2.1.6 Pipe and Fittings

##### 2.1.6.1 Low flow outlet piping, including drain pipe.

The pipe shall be a minimum thickness of 3/8-inch ASTM A 53 steel. All internal surfaces, exposed (not embedded) surfaces and the first 3 feet of external surfaces of embedded pipe entering any concrete structure shall be painted **as follows:**

**A. INTERNAL LINING (PAINTING) AND EXTERIOR SURFACES NOT EXPOSED TO SUN LIGHT. All pipe shall be coated with Fusion Bonded Epoxy. The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel**

Water Pipelines," except that the surface preparation shall be SSPC-SP5 (white metal blast cleaning). The coating shall be applied using the fluidized bed process.

For field repairs or where, as confirmed by the Contracting Officer, it would be impossible to use the powder epoxy method without causing damage to the item, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a Dry Film Thickness (DFT) of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.

Coating (DFT = 16 mils), Scotchkote 203, Miccron 650, Miccron 651, or equal. Total system DFT = 16 mils (max.)

**B. EXTERNAL COATING SYSTEM FOR SURFACES EXPOSED TO SUN LIGHT.**

Urethane Coating: All exposed pipe exteriors shall be coated with the following system:

Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning).

Primer shall be an epoxy based primer compatible for use with urethane finishes. Suitable primers include Glidden 5229, Koppers Hi Gard Epoxy, Tnemec 69, or an approved equal. One prime coat to the manufacturer's recommended thickness for the intended application.

Suitable urethane finish coats shall be Glidden 6200/6252 Glid-Thane II, Koppers Carbonthane 134HS, Tnemec Series 75 Color, or an approved equal. Coatings shall be applied according to manufacturer's recommendations and as necessary to reach total system thickness.

Total system DFT = 7 mils minimum provided it does not exceed manufacturer's recommendations.

2.1.1.6.2 Conduit Fill Lines

The R.O. conduit fill pipe shall be 4-inch Schedule 40 Stainless Steel conforming to the requirements of ASTM A 312, Grade TP 304. Schedule 40S and pipe fittings shall be of stainless steel ASTM A 182, Grade F 304, 150 pound class.

The low flow outlet fill pipe shall be 3-inch Schedule 40 Stainless Steel conforming to the requirements of ASTM A 312 Grade TP 304, Schedule 40S and pipe fitting shall be of stainless steel ASTM A 182, Grade F304, 150 pound class.

2.1.1.6.3 Instrumentation Piping

The copper piping shall be Type K hard drawn, solder joint, conforming to FS WW-T-799.

2.1.1.6.4 Welded Steel Fittings

Flanges shall be 300 psi forged steel, slip-on when used on pipe and welding neck when used on fittings. Pipe flanges larger than 24-inch shall be AWWA class E meeting AWWA C207 standards. Pipe flanges smaller than 24-inch shall be ANSI B16.5.

2.1.1.6.5 Copper Pipe Fittings

Wrought copper, solder joint ANSI B16.22 or cast brass solder-joint ANSI B16.18.

#### 2.1.7 Unions

FS WW-U-516, or FS WW-U-531, as applicable. Unions in copper and brass lines shall be bronze.

#### 2.1.8 Solder

FS QQ-S-571, Composition Sn50 (or Sb5-- to be used where designated). Flux shall conform to FS 0-F-506.

### PART 3 EXECUTION

#### 3.1 INSTALLATION OF PIPING

##### 3.1.1 General

The installation of all piping, valves, fittings, and related accessories shall be made as shown and specified. Prior to installation, all pipe, valves, and fittings shall be clean. Care shall be exercised not to damage the pipe, valves, fittings or any accessories during installation. For installation of instrumentation piping see paragraph: INSTRUMENTATION PIPING.

##### 3.1.2 Coordination with Other Work

The piping covered by this section shall be installed in coordination with all other work so that all piping is installed in the most direct and workmanlike manner, and so that interferences between piping, ducts, equipment, architectural and structural features shall be avoided if possible. In case interferences do develop, the Contracting Officer shall decide which work shall be relocated regardless of which work was first installed. The structure shall not be cut or weakened when installing the piping and equipment.

##### 3.1.3 Pipe Joints

###### 3.1.3.1 General

Drawings show the minimum pipe joints required. Additional joints may be provided as necessary to fabricate and install pipe or to facilitate galvanizing pipe after fabrication. Unions or flanged connections shall be provided in all steel lines downstream of valves, and so located that the valves or equipment can be removed for repair or replacement without removing an excessive amount of piping. Pipe joints in steel pipe, 2-1/2 inches and smaller in diameter shall be made with threaded pipe, fittings and valves unless shown otherwise. Pipe joints in steel pipe 3 inches and larger shall be welded, flanged or grooved type.

###### 3.1.3.2 Threaded Joints

Threaded joints shall conform to ANSI B2.1. Screwed joints shall be made with lubrication applied on the male threads only. Screwed joints shall be made metal to metal, and caulking of screwed joints to stop or prevent leakage shall not be permitted. Joints for water lines shall be lubricated with graphite in linseed oil, Teflon tape, oil, or other approved compound.

The exposed threads on ferrous pipe shall be coated with zinc rich paint after assembly.

#### 3.1.3.3 Flanged Joints

Flanges shall be of forged steel and 300 pound class unless otherwise specified or indicated. Slip-on flanges shall be used on pipe and welding neck flanges used with fittings. When steel flanges are to be bolted to cast iron valves or equipment having cast iron flanges, the 1/16-inch raised face on the steel flanges shall be removed. Joints shall be made up tight using 1/16-inch thick composition gaskets. Gaskets shall be the ring type for raised face flanges and full faced for flat faced flanges. Steel bolts shall be used for bolting flanged joints.

#### 3.1.3.4 Welded Joints

Joints shall be made by qualified welders and shall meet the requirements of AWWA C206 and applicable requirements of ANSI B31.1. Welders and welding procedures shall be qualified in accordance with the requirements of ANSI B31.1 and AWWA C206. Welding shall be in accordance with provisions of ANSI Z49.1. Butt welding joints shall have pipe and fitting ends prepared in accordance with ANSI B16.25 and shall have a root weld no larger than 5/32-inch. Welding fitting wall thickness shall be equal to or thicker than the pipe wall thickness. Mitered joints shall be used only when shown on the specification drawings. Welded joints in galvanized lines shall be hot-dipped galvanized after fabrication except that field welded joints in galvanized lines, when specifically approved, shall be coated with zinc rich paint or galvanizing repair compound.

#### 3.1.3.5 Solder Joints

Solder joints in copper tubing shall be soldered using 50-50 solder and petrolatum type flux. Solder joints shall have the ends of the pipe cut square with all burrs removed and the end of the pipe thoroughly cleaned on the outside with emery or steel wool for a distance equal to the depth of the fitting socket. Tubing shall be clean and bright with no dark spots. The fitting socket shall likewise be thoroughly cleaned. The tubing shall be firmly seated in the fitting socket which shall be rotated several times to insure an even distribution of the flux. In cold weather the fitting shall be warmed with a torch to between approximately 70 and 80 degrees F. The fitting shall then be evenly heated with a torch and solder fed into the joint until it appears around the end of the fitting at the tubing circumference. Care shall be taken to prevent annealing of the tube and fittings when making connections.

#### 3.1.3.6 Dielectric Connections

Connections between ferrous and nonferrous metallic pipe and equipment in water and air lines shall be made with dielectric unions or flanges. Piping entering or leaving the structure shall have a dielectric connection inside the building.

#### 3.1.4 Embedded Pipe

Pipe to be embedded in concrete shall be located to line and grade and shall be braced securely to avoid displacement during the placement of concrete. During progress of the work all pipe to be embedded in any one pour shall be connected to previously embedded pipe or securely capped or plugged with solid wooden or metallic closures prior to starting the pour.

Caps of plugs shall not be laced until all runs of piping affected are free and clear of internal obstructions. No cap or plug shall be removed without approval. Failure to observe these instructions shall result in the Contractor required to perform a complete flow test to demonstrate that the runs involved are free from obstructions. Embedded piping shall not be used for disposal of concrete curing water or other construction drainage.

### 3.1.5 Mechanical Joints/Couplings and Wrappings

The mechanical joints/couplings shall be Dresser Style 38 or approved equal. The burlap wrap shall be supported by sheet metal to assure an unobstructed void between couplings and between the pipe and burlap wrap.

### 3.1.6 Concrete Anchors

Concrete anchors shall be installed in accordance with the recommendations of the manufacturer.

## 3.2 INSTRUMENTATION PIPING

### 3.2.1 General

The water pressure sensing system will be used to monitor the water pressure in the regulating outlet conduit at various locations. The pressure data will be used to control the operation of the outlet works. The water pressure sensing system draws water through 1/4-inch diameter holes in surface mounted plates located in the wet well and the RO conduit.

The water is transported through a system of pipes to the RO gate structure, where the pressure is measured with specified instrumentation. The pressure data shall then be transferred through telemetry to a remote location.

### 3.3 OUTLET CONDUIT FILL LINES

The RO and low flow conduit fill lines shall be furnished, installed and capped as required in SECTION 15301: FILLING SYSTEMS FOR REGULATING AND LOW FLOW OUTLETS.

### 3.4 PRESSURE TESTS

#### 3.4.1 General

The tests shall be made with blank flanges or with suitable caps on ends of the pipe sections to be tested. The piping tests shall be conducted before the equipment has been connected to the piping. All sections of the piping specified herein shall be tested and approved before acceptance. Any defects or leaks disclosed by tests shall be repaired and retested. The Contracting Officer shall be notified in sufficient time before starting any test to permit them to witness the test. Each welded joint shall be hammered while under test pressure. All piping shall be tested at the pressure shown in the following table for a length of time necessary to determine tightness but in no case less than one hour. A drop in pressure of more than 5 percent during the test period will be considered failure and subsequent repairs and retesting will be required.

#### 3.4.2 Test Pressure and Mediums

The test pressure and mediums are shown in the table for the following categories of piping:

## TEST PRESSURES AND MEDIUMS

	Test Pressure (psig)	Test Media
1. Water Conduit Filling Line	250	Water
2. Low Flow Outlet Pipes	250	Water
3. Water Pressure Sensor Piping	250	Water

## 3.5 PAINTING

All painting under this section shall conform to the provisions of SECTION 09940: PAINTING HYDRAULIC STRUCTURES AND APPURTENANT WORKS.

-- End of Section --

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