



**US Army Corps  
of Engineers**

Los Angeles District

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## Robles Diversion Dam Restoration

### Construction Specifications

**February 2013**



**TETRA TECH**

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## SECTION 00010

## BID SCHEDULE

## PART 1 GENERAL

The numerical sequences of the bid items is not meant to determine for the Contractor the sequencing of the work.

## 1.1 Bid Items

Item	Description	Quantity	Unit		Amount
			Unit	Price	
0001	MOBILIZATION AND DEMOBILIZATION	1.00	Job	LS	\$_____.
0002	DIVERSION AND CONTROL OF WATER	1.00	Job	LS	\$_____.
0003	CLEAR SITE AND REMOVE OBSTRUCTIONS	1.00	Job	LS	\$_____.
0004	EXCAVATION	72,495	CY	\$__.	\$_____.
0005	IMPERVIOUS FILL	1,305	CY	\$__.	\$_____.
0006	STRUCTURAL CONCRETE- SPILLWAY		CY	\$__.	\$_____.
0007	STRUCTURAL CONCRETE- HIGH FLOW		CY	\$__.	\$_____.
0008	STRUCTURAL CONCRETE- FISH LADDER		CY	\$__.	\$_____.
0009	SPILLWAY SILL PLATE		EA	\$__.	\$_____.
0010	4-FT CUTOFF WALL	606	LF	\$__.	\$_____.
0011	6-FT CUTOFF WALL	366	LF	\$__.	\$_____.
0012	LOW FLOW CHANNEL CROSSING	350	LF	\$__.	\$_____.
0013	CLASS 2 BASE ROADWAY	3882	SY	\$__.	\$_____.
0014	36" MIN. THICK ROCK RAMP	32346	TON	\$__.	\$_____.

## Bid Items - Continued

0015	36" THICK RIPRAP	2627	TON	\$__.	__\$	_____.	____
0016	36" THICK GROUTED RIPRAP	6608	TON	\$__.	__\$	_____.	____
0017	FISH LADDER RIPRAP	460	TON	\$__.	__\$	_____.	____
0018	60" THICK OVERSIZED RIPRAP	7626	TON	\$__.	__\$	_____.	____
0019	CONCRETE ACCESS ROAD	1075	CY	\$__.	__\$	_____.	____
0020	4-FT WEIR BOULDER	852	TON	\$__.	__\$	_____.	____
0021	EX FISHWAY FILL MATERIAL	581	EA	\$__.	__\$	_____.	____
0022	HYDROSEEDING	20	Acre	\$__.	__\$	_____.	____
0023	SUBDRAINAGE SYSTEM	381	LF	\$__.	__\$	_____.	____
0024	TRASH RACK EXTENSION	1	EA	\$__.	__\$	_____.	____
0025	OVERSHOT GATE	1	EA	\$__.	__\$	_____.	____
0026	TAINTER GATES	4	EA	\$__.	__\$	_____.	____
0027	TRUNNION	8	EA	\$__.	__\$	_____.	____
0028	GUIDE WHEEL ASSEMBLY	16	EA	\$__.	__\$	_____.	____
0029	SEAL ASSEMBLY	4	EA	\$__.	__\$	_____.	____
0030	HOIST ASSEMBLY	4	EA	\$__.	__\$	_____.	____
0031	EMBEDDED ITEMS	4	EA	\$__.	__\$	_____.	____
0032	16' EXISTING GATE EXTENSION	3	EA	\$__.	__\$	_____.	____

## Bid Items - Continued

0033 10' EXISTING GATE EXTENSION 1 EA \$ \_\_. \_\_ \$ \_\_\_\_\_. \_\_\_\_

**TOTAL ESTIMATED AMOUNT OF BID:** \$ \_\_\_\_\_.

## Abbreviations:

Ft	=	foot	ton	=	english ton (1000 lbs)
Ft <sup>2</sup>	=	square foot	LS	=	lump sum
Ft <sup>3</sup>	=	cubic feet	LF	=	linear foot
CY	=	cubic yards	LBS	=	pounds
EA	=	each			

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

-- End of Section --

## 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.

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Change 1-2010; Change 3-2010;  
Errata 1-2010) Safety and Health  
Requirements Manual

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

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 14 calendar 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.

## 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.

#### 1.6 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 ensure 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 ensure 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.

#### 1.7 PUBLIC UTILITIES, NOTICES, AND RESTRICTIONS

##### 1.7.1 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 plans. 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.

##### 1.7.2 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.

### 1.7.3 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.

### 1.7.4 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.

### 1.7.5 Notices

#### 1.7.5.1 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.

#### 1.7.5.2 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.

#### 1.7.5.3 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.

#### 1.7.6 Restrictions

##### 1.7.6.1 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.

##### 1.7.6.2 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.

##### 1.7.6.3 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.

#### 1.8 ROADS AND CULVERTS

##### 1.8.1 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.

##### 1.8.2 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.

#### 1.8.2.1 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).

#### 1.8.3 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.

#### 1.8.4 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.

#### 1.8.5 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.

##### 1.8.5.1 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.

#### 1.9 TRAFFIC SAFETY

##### 1.9.1 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.

#### 1.9.2 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.

#### 1.10 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.

#### 1.11 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.

#### 1.12 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.

#### 1.13 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.

#### 1.14 PERMITS

##### 1.14.1 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.

#### 1.14.1.1 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. The Contractor shall maintain a current copy of the plan on-site, and shall comply with all provisions of the plan. 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 REQUIRED INSURANCE

##### 1.15.1 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.

##### 1.15.2 Insurance

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

##### 1.15.3 Insurance Policy

Each insurance policy required by this contract shall contain the following four 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) U.S. Army Corps of Engineer, (2) Ventura County Flood Control and Water Conservation District, and (3) Tetra tech, Inc.
- b. "All rights of subrogation are hereby waived against the U.S. Corps of Engineers and the County of Ventura 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".
- c. "As respects operation of the named insured performed on behalf of the Government, the following are added as additional insureds:
- d. "It is agreed that any insurance maintained by US Corps of Engineers and Ventura County Flood Control 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.

## LIABILITY INSURANCE

Worker's Compensation

Statutory

## 1.15.4 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.

## 1.15.5 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.

## 1.15.6 Worker's Compensation

Each liability and worker's compensation insurance policy required by this contract shall contain clause numbers 1.15.4 (a.) and 1.15.4 (c.) above, and the following clause: "It is agreed that any insurance maintained by the County of Ventura will apply in excess of, and not contribute with, insurance provided by this policy."

## 1.15.6.1 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.

## 1.15.6.2 Contractor Agrees to Indemnify

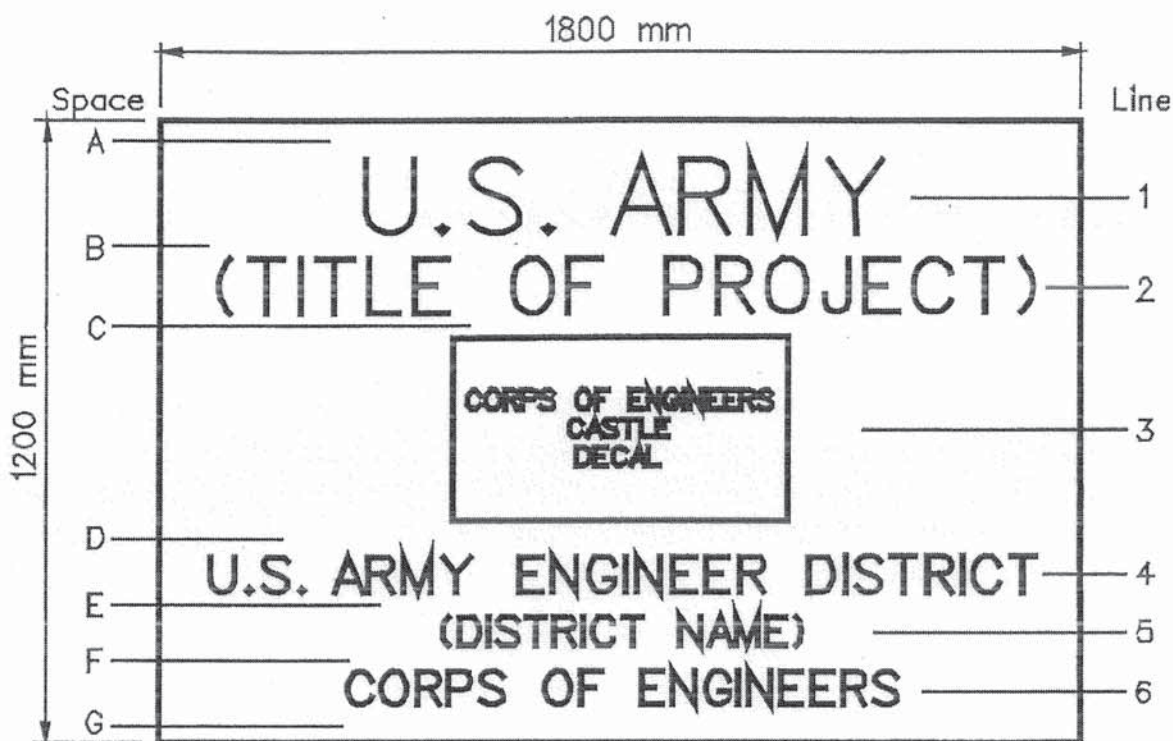
Contractor agrees to indemnify and save harmless agency, its officers, employees, agents and volunteers from and against any and all claims, actions, losses, damages and/or liability arising out of this contract from any cause whatsoever, including the acts, errors or omissions of any person, except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

PART 2 PRODUCTS (NOT APPPLICABLE)

PART 3 EXECUTION (NOT APPPLICABLE)

-- End of Section --





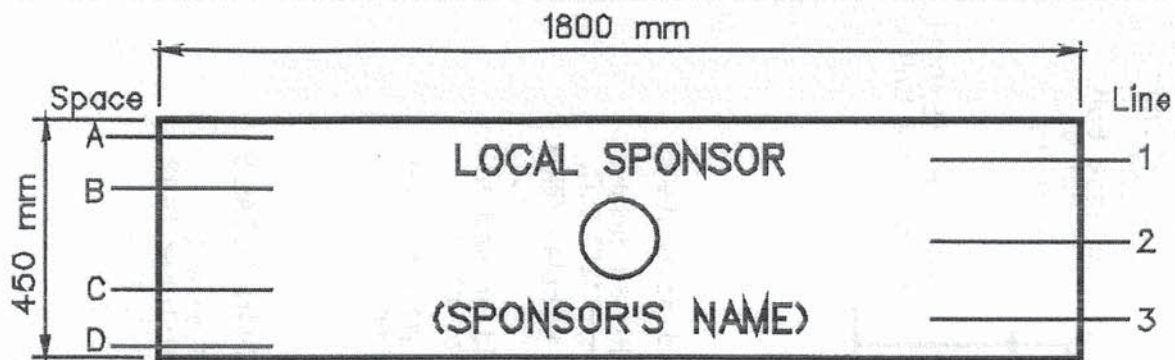
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A	75	1	U.S. ARMY	140	22
B	50	2	PROJECT NOMENCLATURE	100	16
C	50	3	CORPS OF ENGINEERS CASTLE (DECAL)	345	
D	70	4	U.S. ARMY ENGINEER DISTRICT	70	9
E	50	5	DISTRICT NAME	60	6
F	50	6	CORPS OF ENGINEERS	65	9
G	75				

Letter Color -- Black

PROJECT SIGN  
(Army-Civil Works)

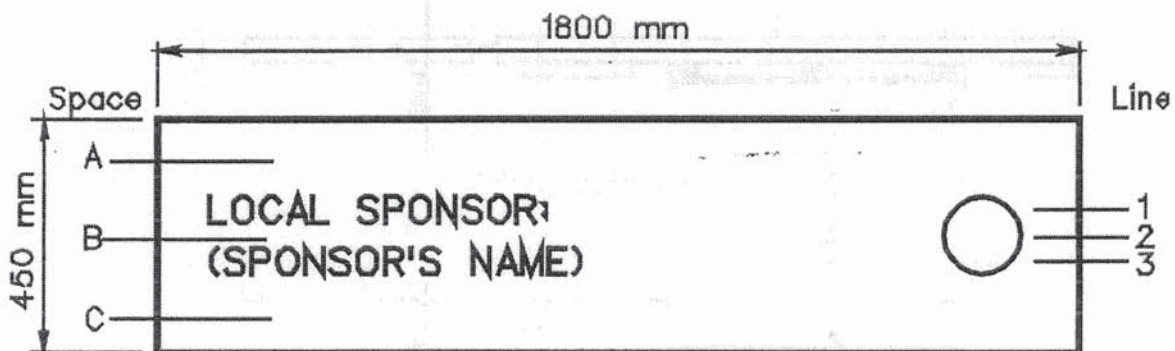
Figure 1  
October 1995

All units are in millimeters.



Space	Height	Line	Description	Letter Height	Stroke
A	50	1	LOCAL SPONSOR	50	9
B	50	2	SPONSOR'S EMBLEM (DECAL)		
C	50	3	(SPONSOR'S NAME)	50	9
D	50				

- OR -



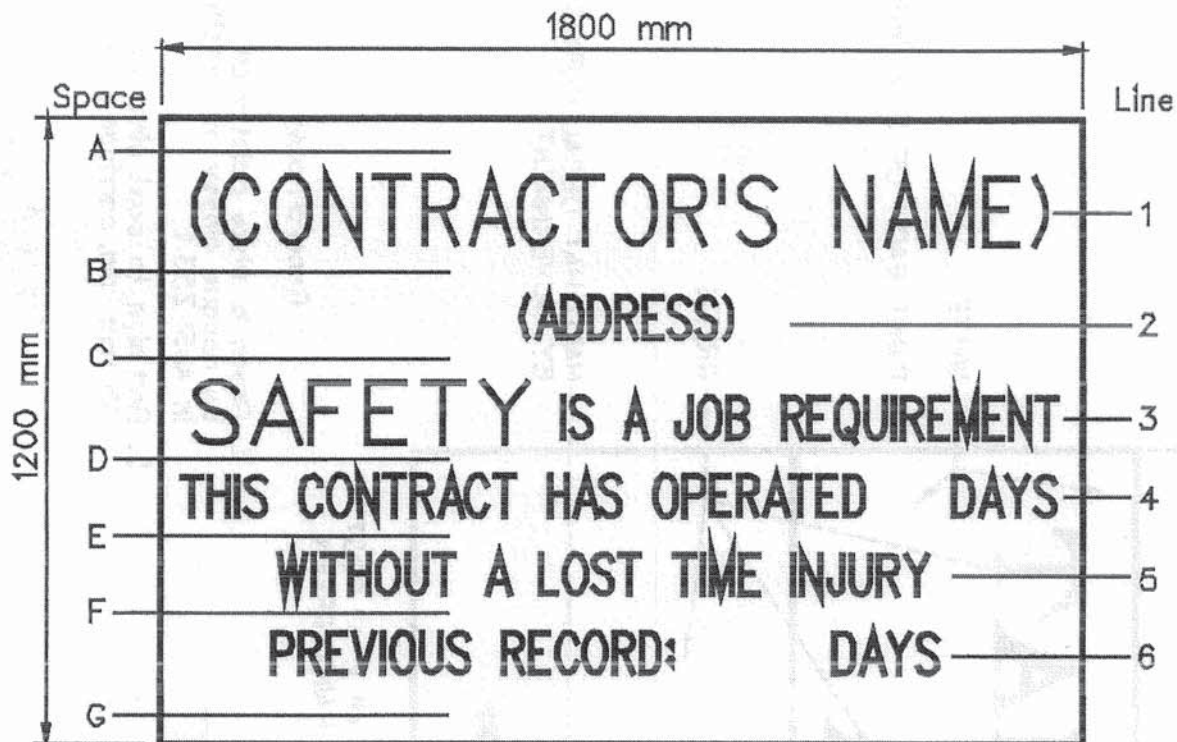
Space	Height	Line	Description	Letter Height	Stroke
A	150	1	LOCAL SPONSOR	50	9
B	50	2	SPONSOR'S EMBLEM (DECAL)		
C	150	3	(SPONSOR'S NAME)	50	9

Lettering Color -- Black

Figure 1A  
October 1997

All units are in millimeters.





## SCHEDULE

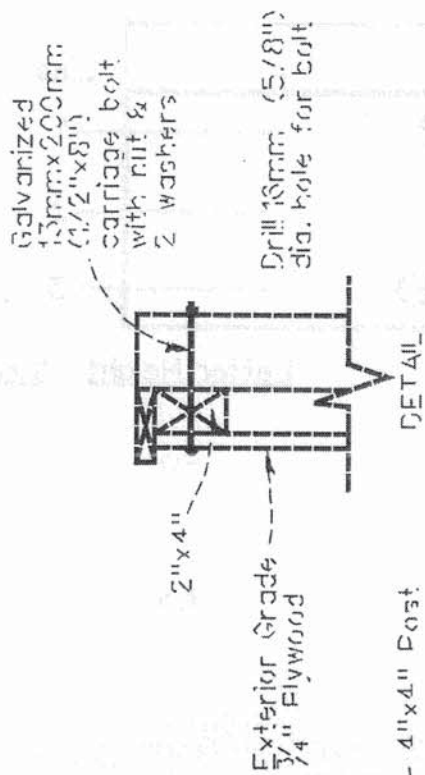
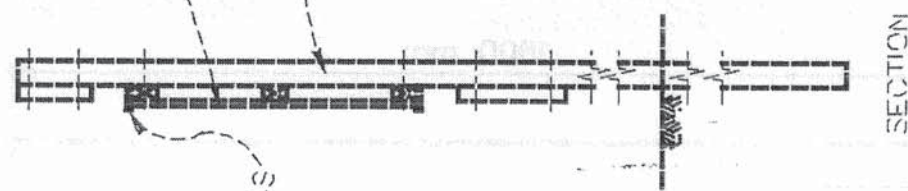
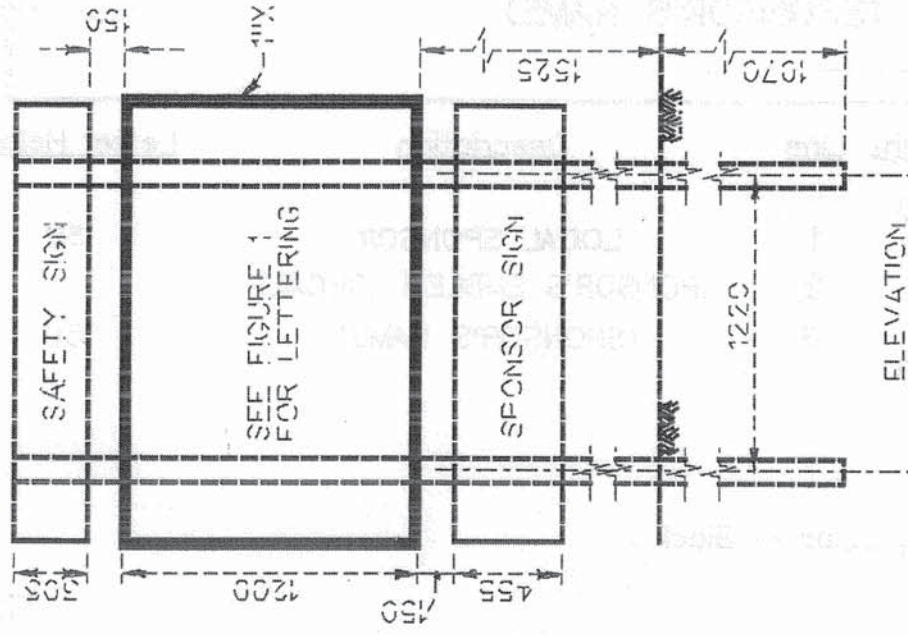
<u>Space</u>	<u>Height</u>	<u>Line</u>	<u>Description</u>	<u>Letter Height</u>
A	105	1	CONTRACTOR'S NAME	125
B	75	2	ADDRESS	75
C	150	3	SAFETY IS A JOB REQUIREMENT	115 & 75
D	75	4	ALL LETTERING	75
E	75	5	ALL LETTERING	75
F	75	6	ALL LETTERING	75
G	105			

### NOTE:

LETTERING SHALL BE BLACK No. 2703B, FEDERAL STANDARD 595.  
SIGN SHALL BE INSTALLED IN THE SAME MANNER  
AS THE PROJECT SIGN.

SAFETY SIGN  
Figure 1B  
October 1997

All units are in millimeters.



# General Notes

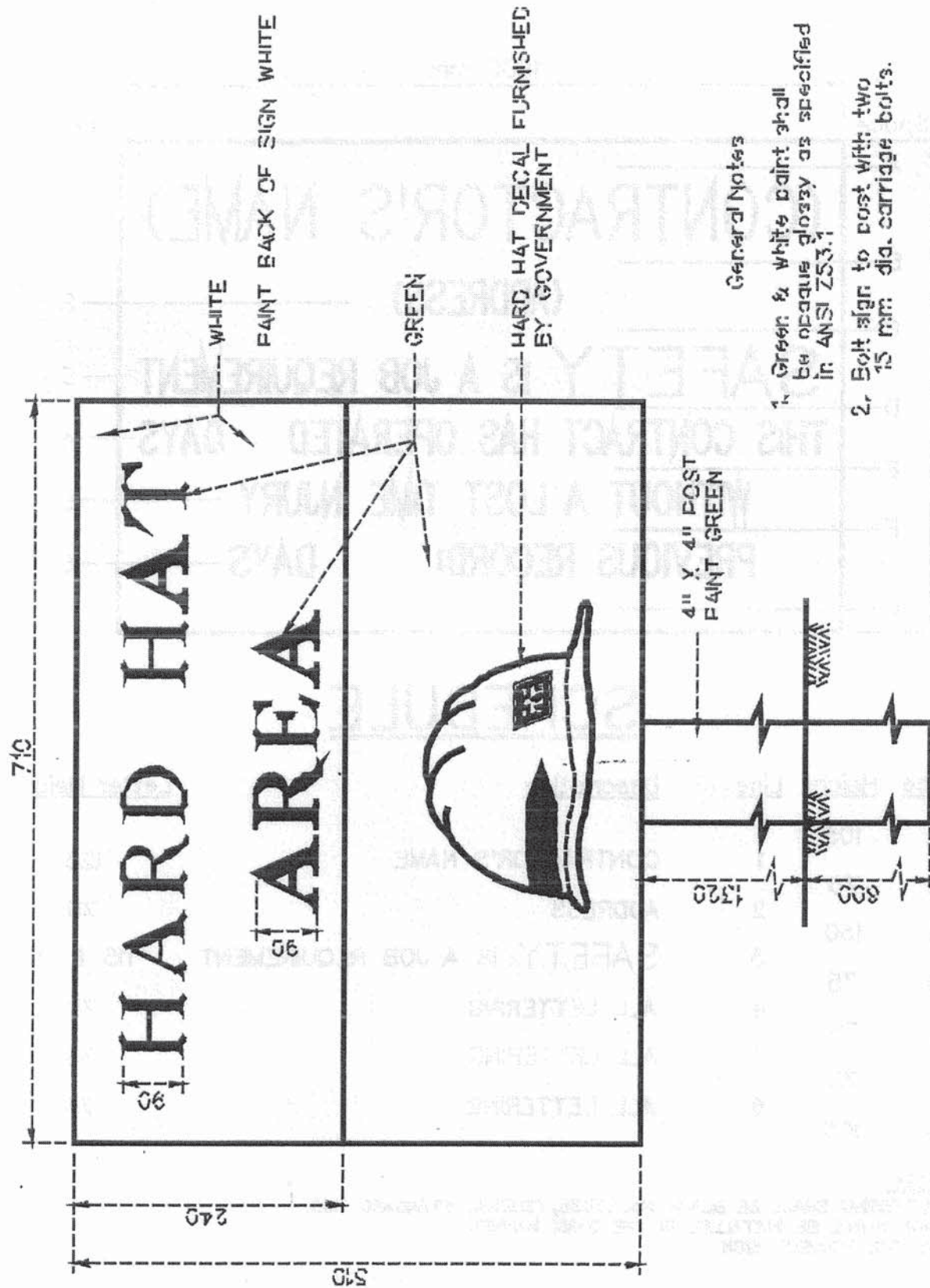
1. Lumber to be cut & formed accurately.
2. Secure 1"x4" & plywood with 8d finish nails at not less than 305mm (12") O.C.
3. All exposed nails to be set & holes filled with putty.
4. Sign to be set in good solid ground & backfill carefully tamped into place.
5. Where necessary, posts shall be braced to provide a solid installation.

# SIGN DETAILS

Figure 2  
October 1998

All units are in millimeters unless otherwise indicated.





#### General Notes

1. Green & white paint shall be opaque glossy as specified in ANSI Z53.1
2. Bolt sign to post with two 15 mm dia. carriage bolts.

Figure 3  
October 1998

All units are in millimeters unless otherwise indicated.

## SECTION 01270

## MEASUREMENT AND PAYMENT

## PART 1 GENERAL

## 1.1 LUMP SUM PAYMENT ITEMS

Payment items for the work of this contract for which contract lump sum payments will be made are listed in the BIDDING SCHEDULE and described below. All costs for items of work, which are not specifically mentioned to be included in a particular lump sum or unit price payment item, shall be included in the listed lump sum item most closely associated with the work involved. The lump sum price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided.

## 1.1.1 Mobilization and Demobilization

## 1.1.1.1 Payment

Payment for MOBILIZATION AND DEMOBILIZATION will be made at the applicable contract price, which payment shall constitute full compensation for all applicable in accordance with SECTION 01200- GENERAL REQUIREMENTS.

## 1.1.1.2 Measurement

Unit of measure: lump sum

## 1.1.2 Diversion and Control of Water

## 1.1.2.1 Payment

Payment for Diversion and Control of Water will be made at the applicable contract price, which payment shall constitute full compensation for dewatering the work area and diverting and controlling the water in the diversion dam and other work areas in accordance with Section 02130 DIVERSION AND CONTROL OF WATER.

## 1.1.2.2 Measurement

Unit of measure: lump sum

## 1.1.3 Clear Site and Remove Obstructions

## 1.1.3.1 Payment

Payment will be made for costs associated with all work and operations necessary for clear site and remove obstructions in accordance with Section 02100 CLEAR SITE AND REMOVE OBSTRUCTIONS. Payment for clear site and remove obstructions shall include applicable earthwork, grubbing, filling holes, removal of materials for salvage, removal of existing surface and debris and removal of trees and vegetation from within areas to be excavated and areas to receive fills, structures and stockpiles,

protection, replacement or restoration of existing structures and features and disposal of all materials.

#### 1.1.3.2 Measurement

Unit of measure: lump sum

### 1.2 UNIT PRICE PAYMENT ITEMS

Payment items for the work of this contract on which the contract unit price payments will be made are listed in the BIDDING SCHEDULE and described below. The unit price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for each of the unit price items.

#### 1.2.1 Excavation

##### 1.2.1.1 Measurement

A survey of the site shall be made by the Contractor prior to commencement of work, and all measurements will be based on the differences between this survey and the design surface, without regard to any changes on the site that may be made between the excavation lines and grades indicated on the drawings or staked in the field and the ground surfaces as indicated by the above mentioned survey. The actual slopes as excavated may be greater or less than those indicated or staked, depending on the materials excavated and methods used in performing the work, but such alterations shall not change the measurement for payment from the original lines as specified herein. The quantity of directed excavation necessary for the removal of unsatisfactory foundation material as specified should be included in the measurement of the excavation where the unsatisfactory soils are encountered. Quantities will be computed in cubic yards by the average end area method and the plan meter will be considered a precise instrument for measurement of plotted cross sections. The Contractor has the option of using computer methods for quantity estimations, but all computer methods of quantity estimations shall be approved by the Contracting Officer. All excavation outside of excavation lines shown on the drawings will be considered as being for convenience of the Contractor.

Unit of measure: cubic yard

##### 1.2.1.2 Payment

Payment for excavation will be made at the applicable contract price, which payment shall constitute full compensation for excavation for the dam foundations, channels, basins, roads and other areas as indicated on the drawings including shoring, shaping and trimming of areas to receive riprap, concrete; or embankment material, loading, stockpiling, processing, hauling, and dumping suitable materials for fills for the dam embankments, and backfill for structures and pipes; loading, stockpiling, hauling, dumping excess satisfactory excavated materials in disposal sites shown on drawings or directed; and any costs associated with offsite disposal of unsatisfactory materials. Payment will not be included for excavation outside the excavation limits indicated on the drawings or staked in the field, and other earthwork requirements for which separate payments are provided.

### Subgrade or Foundation Preparation

No separate payment will be made for subgrade or foundation preparation and all costs in connection therewith shall be included in the contract prices for excavation or the items to which the work applies.

### Unsatisfactory Soils

No separate payment will be made for the excavation and disposal of unsatisfactory soils. When such excavation is directed, payment will be made based on the contract unit prices for the items to which the work applies.

### Excavation for Structures

No separate payment will be made for excavation for structures such as side drain, catch basin, floodwalls, etc. All costs in connection therewith shall be included in the applicable contract item to which the work applies.

### Trenches

No separate payment will be made for the excavation and disposal of pipe trenches. All costs in connection therewith shall be included in the applicable contract prices for the items to which the work applies.

### Shoring

No separate payment will be made for shoring. All costs in connection therewith shall be included in the applicable contract prices for the items to which the work applies. The Contractor shall be responsible for method of construction and the use of shoring, stable slope cuts, or other trench safety requirements.

## 1.2.2 Impervious Fill

### 1.2.2.1 Measurement

Measurement for impervious fill will be made between the excavation and structure lines and the fill limit lines, or between the pre-construction surveyed ground lines and fill lines, as indicated or staked in the field. Quantities will be computed in cubic yards by the average end area method and the planimeter will be considered a precise instrument for measuring plotted cross sections. The Contractor has the option of using computer methods of quantity estimation, but all computer methods of quantity estimation shall be approved by the Contracting Officer.

Unit of measure: cubic yard

### 1.2.2.2 Payment

Payment for impervious fill will be made at the applicable contract unit price per cubic yards, which payment shall include full compensation for impervious fill, dam embankment, spillway, backfill cutoff walls, and other areas as indicated on the drawings including, placing, shaping, grading, foundation preparation backfill, and compacting the fill, complete. Payment will not be included for fills outside the fill limits indicated on the drawings or staked in the field, and other fill requirements for which separate payments are provided.



### Subgrade Preparation

No separate payment will be made for subgrade preparation for areas of fill, and all costs in connection therewith shall be included in the contract prices.

### Backfill About Structures

No separate payment will be made for backfill about structures. All costs in connection therewith shall be included in the applicable contract prices for items to which the work applies.

### Trenches

No separate payment will be made for backfilling pipe including bedding material, selected granular material, or initial backfill material. All costs in connection therewith shall be included in the contract prices for items to which the work applies.

### Compacted Fill, Roadways

Payment for compacted fill, roadways will be made at the applicable contract unit price per cubic yards, which payment shall constitute full compensation for placing, shaping, grading, and compacting the fill, complete.

## 1.2.3 Structural Concrete - Spillway

### 1.2.3.1 Payment

Payment for Structural Concrete- Spillway will be made at the applicable contract price, which payment shall constitute full compensation for subgrade preparation, forming, obtaining and placing concrete and steel reinforcement in the footings and walls and all necessary incidentals, complete per details shown on the plans. The basis of payment shall be the neat lines of the concrete as shown on the plans or the approved lines adjusted to fit field conditions. Concrete tickets shall not be used to determine the concrete quantities placed. Excavation for Structural Concrete- Spillway construction will be paid for under Excavation. Coloring and texturing of the concrete, if required by the plans and/or project specifications, are included in this pay item. Steel reinforcement is included in this pay item.

### 1.2.3.2 Measurement

Unit of measure: cubic yard

## 1.2.4 Structural Concrete - High Flow

### 1.2.4.1 Payment

Payment for Structural Concrete- High Flow will be made at the applicable contract price, which payment shall constitute full compensation for subgrade preparation, forming, obtaining and placing concrete and steel reinforcement and all necessary incidentals, complete per details shown on the plans. The basis of payment shall be the neat lines of the concrete as shown on the plans or the approved lines adjusted to fit field conditions. Concrete tickets shall not be used to determine the concrete quantities

placed. Excavation for Structural Concrete- High Flow will be paid for under Excavation. Coloring and texturing of the concrete, if required by the plans and/or project specifications, are included in this pay item. Steel reinforcement is included in this pay item.

#### 1.2.4.2 Measurement

Unit of measure: cubic yard

#### 1.2.5 Structural Concrete - Fish Ladder

##### 1.2.5.1 Payment

Payment for Structural Concrete- Fish Ladder will be made at the applicable contract price, which payment shall constitute full compensation for subgrade preparation, forming, obtaining and placing concrete and steel reinforcement and all necessary incidentals, complete per details shown on the plans. The basis of payment shall be the neat lines of the concrete as shown on the plans or the approved lines adjusted to fit field conditions. Concrete tickets shall not be used to determine the concrete quantities placed. Excavation for Structural Concrete- Fish Ladder will be paid for under Excavation. Coloring and texturing of the concrete, if required by the plans and/or project specifications, are included in this pay item. Steel reinforcement is included in this pay item.

##### 1.2.5.2 Measurement

Unit of Measure: cubic yard

#### 1.2.6 Spillway Sill Plate

##### 1.2.6.1 Payment

Payment for Spillway Sill Plate will be made at the applicable contract price, which payment shall constitute full compensation for subgrade preparation, forming, obtaining and placing concrete and steel reinforcement and all necessary incidentals, complete per details shown on the plans. The basis of payment shall be the neat lines of the concrete as shown on the plans or the approved lines adjusted to fit field conditions. Concrete tickets shall not be used to determine the concrete quantities placed. Excavation for Spillway Sill Plate will be paid for under Excavation. Coloring and texturing of the concrete, if required by the plans and/or project specifications, are included in this pay item. Steel reinforcement is included in this pay item.

##### 1.2.6.2 Measurement

Unit of Measure: each

#### 1.2.7 4-ft Cutoff Wall

##### 1.2.7.1 Payment

Payment for 4-ft Cutoff Wall will be made at the applicable contract price, which payment shall constitute full compensation for subgrade preparation, forming, obtaining and placing concrete and steel reinforcement and all necessary incidentals, complete per details shown on the plans. The basis of payment shall be the neat lines of the concrete as shown on the plans or the approved lines adjusted to fit field conditions. Concrete tickets

shall not be used to determine the concrete quantities placed. Excavation for 4-ft Cutoff Wall will be paid for under Excavation. Coloring and texturing of the concrete, if required by the plans and/or project specifications, are included in this pay item. Steel reinforcement is included in this pay item.

#### 1.2.7.2 Measurement

Unit of Measure: linear feet

#### 1.2.8 6-ft Cutoff Wall

##### 1.2.8.1 Payment

Payment for 6-ft Cutoff Wall will be made at the applicable contract price, which payment shall constitute full compensation for subgrade preparation, forming, obtaining and placing concrete and steel reinforcement and all necessary incidentals, complete per details shown on the plans. The basis of payment shall be the neat lines of the concrete as shown on the plans or the approved lines adjusted to fit field conditions. Concrete tickets shall not be used to determine the concrete quantities placed. Excavation for 6-ft Cutoff Wall will be paid for under Excavation. Coloring and texturing of the concrete, if required by the plans and/or project specifications, are included in this pay item. Steel reinforcement is included in this pay item.

##### 1.2.8.2 Measurement

Unit of Measure: linear feet

#### 1.2.9 Low Flow Channel Crossing

##### 1.2.9.1 Payment

Payment for Low Flow Channel Crossing will be made at the applicable contract price, which payment shall constitute full compensation for subgrade preparation, forming, obtaining and placing concrete and steel reinforcement and all necessary incidentals, complete per details shown on the plans. The basis of payment shall be the neat lines of the concrete as shown on the plans or the approved lines adjusted to fit field conditions. Concrete tickets shall not be used to determine the concrete quantities placed. Excavation for Low Flow Channel Crossing will be paid for under Excavation. Coloring and texturing of the concrete, if required by the plans and/or project specifications, are included in this pay item. Steel reinforcement is included in this pay item.

##### 1.2.9.2 Measurement

Unit of Measure: linear feet

#### 1.2.10 Class 2 Base Roadway

##### 1.2.10.1 Payment

Payment for Class 2 Base Roadway will be made at the applicable contract price which payment shall constitute full compensation for furnishing, placing, and compacting the base course, complete including subgrade preparation. No payment will be made under this item for aggregate base course used for streets and roads for which separate payment is provided.

## 1.2.10.2 Measurement

Unit of Measure: square yard

The quantity of Base Course placed outside of the lines and grades indicated on the drawings will be estimated and deducted from the payment quantity.

## 1.2.11 36" Min. Thick Rock Ramp

## 1.2.11.1 Payment

Payment for 36" Min. Thick Rock Ramp will be made at the applicable contact price, which payment shall constitute full compensation for excavation, obtaining and placing the riprap, backfill, complete-in-place. Payment includes the Class 2 permeable material and geotextile underneath the 36" Min. Thick Rock Ramp. **No payment will be made for material required to replace the damaged geotextile during installation, except for additional geotextile ordered by the Contracting Officer in writing.**

## 1.2.11.2 Measurement

Unit of measure: ton

The Contractor shall weigh each load on a certified platform scale and furnish the Contracting Officer with Duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector at the construction site.

## 1.2.12 36" Thick Riprap

## 1.2.12.1 Payment

Payment for 36" Thick Riprap will be made at the applicable contact price, which payment shall constitute full compensation for excavation, obtaining and placing the riprap, backfill, complete-in-place. Payment includes the Class 2 permeable material and geotextile under the 36" Thick Riprap.

## 1.2.12.2 Measurement

Unit of measure: ton

The Contractor shall weigh each load on a certified platform scale and furnish the Contracting Officer with Duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector at the construction site.

## 1.2.13 36" Thick Grouted Riprap

## 1.2.13.1 Payment

Payment for 36" Thick Grouted Riprap will be made at the applicable contact price, which payment shall constitute full compensation for excavation, obtaining and placing the riprap, backfill, grout, complete-in-place. Payment includes the Class 2 permeable material and geotextile underneath the 36" Thick Grouted Riprap. **No payment will be made for material required to replace the damaged geotextile during installation, except for additional geotextile ordered by the Contracting Officer in writing.**

## 1.2.13.2 Measurement

Unit of measure: ton

The Contractor shall weigh each load on a certified platform scale and furnish the Contracting Officer with Duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector at the construction site.

## 1.2.14 Fish Ladder Riprap

## 1.2.14.1 Payment

Payment for Fish Ladder Riprap will be made at the applicable contact price, which payment shall constitute full compensation for excavation, obtaining and placing the riprap, backfill, grout, complete-in-place.

## 1.2.14.2 Measurement

Unit of measure: ton

The Contractor shall weigh each load on a certified platform scale and furnish the Contracting Officer with Duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector at the construction site.

## 1.2.15 60" Thick Oversized Riprap

## 1.2.15.1 Payment

Payment for 60" Thick Oversized Riprap will be made at the applicable contact price, which payment shall constitute full compensation for excavation, obtaining and placing the riprap, backfill, complete-in-place. Payment includes the Class 2 permeable material and geotextile underneath the 60" Thick Oversized Riprap. **No payment will be made for material required to replace the damaged geotextile during installation, except for additional geotextile ordered by the Contracting Officer in writing.**

## 1.2.15.2 Measurement

Unit of measure: ton

The Contractor shall weigh each load on a certified platform scale and furnish the Contracting Officer with Duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector at the construction site.

## 1.2.16 Concrete Access Road

## 1.2.16.1 Payment

Payment for Concrete Access Road will be made at the applicable contact price, which payment shall constitute full compensation for excavation, obtaining and placing the concrete, reinforcement, backfill, complete-in-place. Payment includes the Class 2 permeable material under the Concrete Access Road.

## 1.2.16.2 Measurement

Unit of measure: cubic yard

## 1.2.17 4-ft Weir Boulder

## 1.2.17.1 Payment

Payment for 4-ft Weir Boulder will be made at the applicable contact price, which payment shall constitute full compensation for excavation, obtaining and placing the boulder, backfill, complete-in-place. Payment includes the Class 2 permeable material and geotextile under the 4-ft Weir Boulder.

## 1.2.17.2 Measurement

Unit of measure: ton

The Contractor shall weigh each load on a certified platform scale and furnish the Contracting Officer with Duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector at the construction site.

## 1.2.18 Ex Fishway Fill Material

## 1.2.18.1 Measurement

Measurement for Ex Fishway Fill Material will be made between the existing invert of the structure to the elevation as shown on the drawings.

Unit of measure: cubic yard

## 1.2.18.2 Payment

Payment for Ex Fishway Fill Material will be made at the applicable contract unit price per cubic yards, which payment shall include full compensation for Ex Fishway Fill Material as indicated on the drawings including, placing, shaping, grading, foundation preparation backfill, and compacting the fill, complete.

## 1.2.19 Hydroseeding

## 1.2.19.1 Payment

Payment for Hydroseeding will be made for costs associated with providing all labor, materials, and equipment for furnishing, transporting and hydroseeding the designated areas constituting full compensation for obtaining container plants, mixing and spraying hydroseed, soil preparation, tillage, and weed abatement, complete. Payment will not include seeding or reseeding of areas required as a result of Contractor's negligence or damages caused by Contractor. Payment will be made for costs associated with operations necessary for Hydroseeding as indicated on the plans and in accordance with Section 02900 - HYDROSEEDING.

## 1.2.19.2 Measurement

Unit of Measure: acre

## 1.2.20 Subdrainage System

## 1.2.20.1 Payment

Payment for Subdraiange System shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, Class 2 permeable material and for items that include subdrainage system as shown on the design plans.

## 1.2.20.2 Unit of Measure

Unit of measure: EACH (EA)

## 1.2.21 Debris Rack Extension

## 1.2.21.1 Payment

Payment for Debris Rack Extension shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Debris Rack Extension as shown on the design plans.

## 1.2.21.2 Unit of Measure

Unit of measure: EACH (EA)

## 1.2.22 Overshot Gate

## 1.2.22.1 Payment

Payment for Overshot Gate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Overshot Gate as shown on the design plans.

## 1.2.22.2 Unit of Measure

Unit of measure: EACH (EA)

## 1.2.23 Tainter Gates

## 1.2.23.1 Payment

Payment for Tainter Gates shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Tainter Gates as shown on the design plans.

## 1.2.23.2 Unit of Measure

Unit of measure: pounds (lbs)

## 1.2.24 Trunnion

## 1.2.24.1 Payment

Payment for Trunnion shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Trunnion as shown on the design

plans.

1.2.24.2 Unit of Measure

Unit of measure: pounds (lbs)

1.2.25 Guide Wheel Assembly

1.2.25.1 Payment

Payment for Guide Wheel Assembly shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Guide Wheel Assembly as shown on the design plans.

1.2.25.2 Unit of Measure

Unit of measure: pounds (lbs)

1.2.26 Seal Assembly

1.2.26.1 Payment

Payment for Seal Assembly shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Seal Assembly as shown on the design plans.

1.2.26.2 Unit of Measure

Unit of measure: pounds (lbs)

1.2.27 Hoist Assembly

1.2.27.1 Payment

Payment for Hoist Assembly shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Hoist Assembly as shown on the design plans.

1.2.27.2 Unit of Measure

Unit of measure: pounds (lbs)

1.2.28 Embedded Items

1.2.28.1 Payment

Payment for Embedded Items shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of Embedded Items as shown on the design plans.

1.2.28.2 Unit of Measure

Unit of measure: pounds (lbs)



## 1.2.29 16' Existing Gate Extension

## 1.2.29.1 Payment

Payment for 16' Existing Gate Extension shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of 16' Existing Gate Extension as shown on the design plans.

## 1.2.29.2 Unit of Measure

Unit of measure: pounds (lbs)

## 1.2.30 10' Existing Gate Extension

## 1.2.30.1 Payment

Payment for 10' Existing Gate Extension shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for items that include installation and construction of 10' Existing Gate Extension as shown on the design plans.

## 1.2.30.2 Unit of Measure

Unit of measure: pounds (lbs)

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 01330

## SUBMITTAL PROCEDURES

## PART 1 GENERAL

## 1.1 DEFINITIONS

## 1.1.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections.  
Submittals are identified by SD numbers and titles as follows.

## SD-01 Preconstruction Submittals

Certificates of insurance.  
Surety bonds.  
List of proposed subcontractors.  
List of proposed products.  
Construction Progress Schedule.  
Submittal register.  
Schedule of prices.  
Health and safety plan.  
Work plan.  
Quality control plan.  
Environmental protection plan.

## SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

## SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

## SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color

samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

#### SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

#### SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

#### SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

#### SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

#### SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This Data is intended to be incorporated in an operations and maintenance manual or control system.

##### 1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

##### 1.1.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

#### 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. 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

Submittal register; G

#### 1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

##### 1.3.1 Government Approved

Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

##### 1.3.2 Information Only

They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

#### 1.4 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality

Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

#### 1.5 DISAPPROVED SUBMITTALS

If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

#### 1.6 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

#### 1.7 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

#### 1.8 SUBMITTAL REGISTER

At the end of this section is a submittal register showing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. The Contractor shall maintain a submittal register for the project in accordance with Section 01451 - CONTRACTOR QUALITY CONTROL.

#### 1.9 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days

exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

#### 1.10 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

#### 1.11 SUBMITTAL PROCEDURES

Submittals shall be made as follows:

##### 1.11.1 Procedures

##### 1.11.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

#### 1.12 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

#### 1.13 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four (4) copies of the submittal will be retained by the Contracting Officer and two (2) copies of the submittal will be returned to the Contractor.

#### 1.14 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

## 1.15 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR	
(Firm Name)	
_____	Approved
_____	Approved with corrections as noted on submittal data and/or attached sheets(s).
SIGNATURE: _____	
TITLE: _____	
DATE: _____	

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

Not Used

-- End of Section --

<b>TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE</b> For use of this form, see ER 415-1-10; the proponent agency is CECW-CE.					DATE		TRANSMITTAL NO.	
<b>SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS</b> <i>(This section will be initiated by the contractor)</i>								
TO:		FROM:		CONTRACT NO.			CHECK ONE: <input type="checkbox"/> THIS IS A NEW TRANSMITTAL <input type="checkbox"/> THIS IS A RESUBMITTAL OF TRANSMITTAL _____	
SPECIFICATION SEC. NO. <i>(Cover only one section with each transmittal)</i>			PROJECT TITLE AND LOCATION			THIS TRANSMITTAL IS FOR: <i>(Check one)</i> <input type="checkbox"/> FIO <input type="checkbox"/> GA <input type="checkbox"/> DA <input type="checkbox"/> CR <input type="checkbox"/> DA/CR <input type="checkbox"/> DA/GA		
ITEM NO. <small>(See Note 3)</small>	DESCRIPTION OF SUBMITTAL ITEM <small>(Type size, model number/etc.)</small>	SUBMITTAL TYPE CODE <small>(See Note 8)</small>	NO. OF COPIES	CONTRACT DOCUMENT REFERENCE		CONTRACTOR REVIEW CODE	VARIATION <small>Enter "Y" if requesting a variation (See Note 6)</small>	USACE ACTION CODE <small>(Note 9)</small>
				SPEC. PARA. NO. <small>e.</small>	DRAWING SHEET NO. <small>f.</small>			
a.	b.	c.	d.	e.	f.	g.	h.	i.
REMARKS				I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.				
				NAME OF CONTRACTOR			SIGNATURE OF CONTRACTOR	
<b>SECTION II - APPROVAL ACTION</b>								
ENCLOSURES RETURNED <i>(List by item No.)</i>		NAME AND TITLE OF APPROVING AUTHORITY			SIGNATURE OF APPROVING AUTHORITY		DATE	



## INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.
2. Each Transmittal shall be numbered consecutively. The Transmittal Number typically includes two parts separated by a dash (-). The first part is the specification section number. The second part is a sequential number for the submittals under that spec section. If the Transmittal is a resubmittal, then add a decimal point to the end of the original Transmittal Number and begin numbering the resubmittal packages sequentially after the decimal.
3. The "Item No." for each entry on this form will be the same "Item No." as indicated on ENG FORM 4288-R.
4. Submittals requiring expeditious handling will be submitted on a separate ENG Form 4025-R.
5. Items transmitted on each transmittal form will be from the same specification section. Do not combine submittal information from different specification sections in a single transmittal.
6. If the data submitted are intentionally in variance with the contract requirements, indicate a variation in column h, and enter a statement in the Remarks block describing the detailed reason for the variation.
7. ENG Form 4025-R is self-transmitting - a letter of transmittal is not required.
8. When submittal items are transmitted, indicate the "Submittal Type" (*SD-01 through SD-11*) in column c of Section I.  
Submittal types are the following:

SD-01 - Preconstruction	SD-02 - Shop Drawings	SD-03 - Product Data	SD-04 - Samples	SD-05 - Design Data	SD-06 - Test Reports
SD-07 - Certificates	SD-08 - Manufacturer's Instructions	SD-09 - Manufacturer's Field Reports	SD-10 - O&M Data	SD-11 - Closeout	
9. For each submittal item, the Contractor will assign Submittal Action Codes in column g of Section I. The U.S. Army Corps of Engineers approving authority will assign Submittal Action Codes in column i of Section I. The Submittal Action Codes are:

A -- Approved as submitted.	F -- Receipt acknowledged.
B -- Approved, except as noted on drawings. Resubmission not required.	X -- Receipt acknowledged, does not comply with contract requirements, as noted.
C -- Approved, except as noted on drawings. Refer to attached comments. Resubmission required.	G -- Other action required ( <i>Specify</i> )
D -- Will be returned by separate correspondence.	K -- Government concurs with intermediate design. ( <i>For D-B contracts</i> )
E -- Disapproved. Refer to attached comments.	R -- Design submittal is acceptable for release for construction. ( <i>For D-B contracts</i> )
10. Approval of items does not relieve the contractor from complying with all the requirements of the contract.

SUBMITTAL REGISTER											CONTRACT NO.						
TITLE AND LOCATION Robles Diversion Dam						CONTRACTOR											
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION OR REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY						REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01200	SD-01 Preconstruction Submittals														
			Location of Contractor's Office	1.4													
			SD-02 Shop Drawings														
			Temporary Access and Haul Roads	1.8.2	G												
		01330	SD-01 Preconstruction Submittals														
			Submittal register	1.8	G												
		01355A	SD-01 Preconstruction Submittals														
			Environmental Protection Plan	1.7	G												
		01356A	SD-07 Certificates														
			Mill Certificate or Affidavit	2.1.3													
		01702	SD-11 Closeout Submittals														
			Submittal of the As-Built Field Data	3.1.2.1	G												
		01780	SD-02 Shop Drawings														
			As-Built Drawings	1.2.1	G												
			SD-03 Product Data														
			As-Built Record of Equipment and Materials	1.2.2													
			Warranty Management Plan	1.3.1													
			Warranty Tags	1.3.5													
			Final Cleaning	1.6													
		02130	SD-01 Preconstruction Submittals														
			Diversion and Water Control Plan	1.3.2	G												
		02220	SD-07 Certificates														
			Demolition plan	1.9	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02220	Notifications	1.4.1	G												
			SD-11 Closeout Submittals														
			Receipts														
		02300	SD-01 Preconstruction Submittals														
			Excavation Plan	3.2.2	G												
			SD-06 Test Reports														
			Testing Log	3.4.1.3													
			Borrow Site Testing	2.2													
		02600	SD-02 Shop Drawings														
			Method of Placement	3.2.1	G												
			SD-03 Product Data														
			Stone Sources	2.1.3	G												
			SD-05 Design Data														
			Method of placement	3.2.1	G												
			SD-06 Test Reports														
			Stone Quality Testing	2.1.4.2													
			Gradation Sampling and Testing	2.1.5.2													
			SD-07 Certificates														
			Waybills and Delivery Tickets	3.4.2													
		02650	SD-05 Design Data														
			Grout Mix Design	2.3	G												
			SD-06 Test Reports														
			Aggregates	2.1.1	G												
			SD-07 Certificates														
			Portland Cement	2.1.2	G												
			Curing Compound	2.2	G												

SUBMITTAL REGISTER											CONTRACT NO.						
TITLE AND LOCATION Robles Diversion Dam						CONTRACTOR											
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		02650	Waybills and Delivery Tickets	1.6	G												
		02722	SD-03 Product Data														
			Plant, Equipment, and Tools	1.6													
			Waybills and Delivery Tickets	1.7													
			SD-06 Test Reports														
			Sampling and testing	1.4	G												
			Density Tests	1.4.3.2	G												
		02900	SD-03 Product Data														
			Equipment	3.3.2													
			Delivery	1.4.1													
			Topsoil	2.2	G												
			Quantity Check	3.4	G												
			Seed Establishment Period	3.8	G												
			Maintenance Record	3.8.3.4	G												
			Maintenance Plan	3.8.3.1	G												
			Application of Pesticide	3.5	G												
			Wood cellulose fiber mulch and organic soil stabilizer	3.3.2	G												
			SD-04 Samples														
			Delivered Topsoil	1.4.1.1	G												
			Soil Amendments	2.3	G												
			Mulch		G												
			SD-06 Test Reports														
			Equipment Calibration	3.1.3	G												
			Soil Test	3.1.4	G												
			SD-07 Certificates														

SUBMITTAL REGISTER											CONTRACT NO.						
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		02900	Seed	2.1	G												
			Topsoil	2.2	G												
			pH Adjuster	2.3.1													
			Organic Material	2.3.2													
			Soil Conditioner	2.3													
			Mulch														
			Pesticide	2.6	G												
			Endomycorrhizal Inoculant	2.7													
		03100A	SD-02 Shop Drawings														
			Formwork	3.1.1	G												
			SD-03 Product Data														
			Design	1.3													
			Form Materials	2.1													
			Form Releasing Agents	2.1.6													
		03151A	SD-03 Product Data														
			Splicing Waterstops	2.2.2	G												
			SD-04 Samples														
			Field Molded Sealants and Primer	2.1.2.1													
			Waterstops	2.1.3	G												
			SD-06 Test Reports														
			Premolded Expansion Joint Filler Strips	2.1.1													
			Compression Seals and Lubricant	2.1.2.2													
			Metallic Waterstops														

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		03200A	SD-02 Shop Drawings														
			Reinforcement	3.1	G AE												
			SD-03 Product Data														
			Welding	1.3													
			SD-07 Certificates														
			Reinforcing Steel	2.3													
		03301A	SD-03 Product Data														
			Concrete Mixture Proportioning	2.2	G												
			Batch Plant	3.1.2	G												
			Concrete Mixers	3.1.3													
			Capacity	3.1.1													
			Conveying Equipment	3.1.4													
			Placing Equipment	3.1.1													
			Tests and Inspections	3.6													
			Testing Technicians	3.6.1													
			Concrete Transportation														
			Construction Inspector (CTCI)														
			Concrete Construction Inspector (CCI)														
			Construction Joint Treatment	3.2.4	G												
			Curing and Protection	3.5	G												
			Cold-Weather Placing	3.3.4	G												
			Hot-Weather Placing	3.3.5	G												
			Finishing	3.4	G												
			SD-04 Samples														
			Aggregates		G												

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		03301A	Cementitious Materials, Admixtures, and Curing Compound		G												
			SD-06 Test Reports														
			Quality of Aggregates	3.6.2.3	G												
			Mixer Uniformity	3.6.2.13													
			Tests and Inspections	3.6													
			SD-07 Certificates														
			Cementitious Materials	2.1.1	G												
			Impervious-Sheet Curing Materials	2.1.4.1													
			Air-Entraining Admixture	2.1.3.1													
			Other Chemical Admixtures	2.1.3.4													
			Membrane-Forming Curing Compound	2.1.4.2													
			Membrane-Forming Curing Compound	3.5.2													
			Epoxy Resin	2.1.8													
			Latex Bonding Compound	2.1.7													
		05500	SD-02 Shop Drawings														
			steel stairs		G												
			Handrails	2.3	G												
			Ladders	2.4	G												
			angles and plates	2.5	G												
			SD-03 Product Data														
			Handrails	2.3													

SUBMITTAL REGISTER											CONTRACT NO.						
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		05500	Ladders	2.4													
		05502	SD-02 Shop Drawings														
			Miscellaneous Metal Items	3.1													
			SD-11 Closeout Submittals														
			Satisfactory Installation	3.8													
		05505	SD-01 Preconstruction Submittals														
			Welding Procedure Specifications (WPS)	1.2.3	G												
			Fracture Control Plan (FCP)	1.2.4	G												
			Weld Tracking Log Template	1.2.1	G												
			SD-02 Shop Drawings														
			Shop Drawings	1.4.5	G												
			Assembly	2.1.2	G												
			Welding Repairs - Non-Fracture	2.2.7	G												
			Critical Members														
			Welding Repairs - Fracture	2.2.7	G												
			Critical Members														
			Delivery/Shipping Plan	1.5	G												
			SD-03 Product Data														
			Materials Disposition Record	2.1.3													
			SD-06 Test Reports														
			Certified Test Reports	2.2	G												
			Weld Tracking Log	1.2.2	G												
			Witness Points	1.4													
			SD-07 Certificates														
			Work Plan	1.2	G												



SUBMITTAL REGISTER											CONTRACT NO.						
TITLE AND LOCATION Robles Diversion Dam						CONTRACTOR											
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION OR REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY						REMARKS
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		05505	Qualification of Welders and Welding Operators	1.4.1	G												
			Inspector Qualifications	1.4.2	G												
			Qualification of Structural Steel Fabricator	1.4.3	G												
		09964	SD-01 Preconstruction Submittals														
			Interpretation of Safety, Health, and Environmental Requirements	1.2	G												
			Safety Plan	1.2.1	G												
			Confined Spaces Plan	1.2.1.5	G												
			Respiratory Protection Plan	1.2.1.6	G												
			Airborne Sampling Plan	1.2.2.1	G												
			Ventilation Assessment Plan	1.2.1	G												
			Medical Surveillance Plan	1.2.2	G												
			Lead-Based Paint Worker Protection Plan	1.2.2.2	G												
			Environmental Protection Plan	1.2.3	G												
			Waste Manifest	1.2.3.1	G												
			Waste Classification, Handling, and Disposal Plan	1.2.3.1	G												
			Containment Plan	1.2.3.2	G												
			SD-03 Product Data														
			Manufacturer's Product Data Sheet	Part 2	G												
			SD-04 Samples														
			Product Samples	Part 2	G												

SUBMITTAL REGISTER											CONTRACT NO.						
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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	GOVT OR CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY						REMARKS
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		09964	Special Paint Formulas	2.1	G												
			SD-06 Test Reports														
			Inspection Reports	3.4	G												
			Medical Status Report	1.2.2.2	G												
			Change in Medical Status Report	1.2.2.3	G												
			Air Monitoring Test Plan	1.2.2.1	G												
			Air Monitoring Test Report	1.2.2.1	G												
			SD-07 Certificates														
			Certified EHS Professional	1.4.1	G												
			SSPC-QP 1 Certificate	1.4.2	G												
			SSPC-QP 2 Certificate	1.4.3	G												
			Qualified Hazardous Paint	1.4.3	G												
			Removal Contractor														
			Coating Thickness Gage	1.4.5	G												
			Qualification														
			Qualified Paint Applicator	1.4.4	G												
		11287	SD-02 Shop Drawings														
			Detail Drawings	2.3.1	G												
			SD-03 Product Data														
			Materials	2.1													
			Welding	2.3.3	G												
			SD-04 Samples														
			Materials	2.1	G												
			Manufactured Units	2.2	G												
			Fabrications	2.3.7	G												
			SD-06 Test Reports														

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		11287	Tests, Inspections, and Verifications	2.4													
		11289	SD-02 Shop Drawings														
			Detail Drawings	2.3.1	G												
			SD-03 Product Data														
			Materials	2.1													
			Welding	2.3.3	G												
			SD-04 Samples														
			Materials	2.1	G												
			Manufactured Units	2.2	G												
			Fabrications	2.3.7	G												
			SD-06 Test Reports														
			Tests, Inspections, and Verifications	2.4													
		14601	SD-03 Product Data														
			Electric Wire Rope Hoist	2.3	G												
			SD-06 Test Reports														
			Wire Rope Breaking Strength	1.5.1													
			SD-07 Certificates														
			Compliance with All Listed Standards	1.5.1													
			Loss of Power Test	1.5.1													
			Hazardous Material	1.5.1													
			Brake Settings	1.5.1	G												
		16050	SD-02 Shop Drawings														
			Wiring Diagrams	2.2	G												

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		16050	Installation Details	2.2	G												
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			Shop Drawings	2.2													
		16051	SD-01 Preconstruction Submittals														
			Conduits, Raceways, and Fittings	3.1													
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		16051	Insulation Resistance Test	3.8	G												
			SD-07 Certificates														
			Certification	1.5													
			SD-08 Manufacturer's Instructions														
			Manufacturer's Instructions	1.5													
		16065	SD-01 Preconstruction Submittals														
			Grounding Systems	3.7.2													
			SD-02 Shop Drawings														
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			SD-03 Product Data														
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			Connectors and Fasteners	2.3													
			Bonding	3.6													
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			SD-08 Manufacturer's Instructions														
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		16070	SD-02 Shop Drawings														
			Equipment Requirements	1.3	G												
			SD-03 Product Data														
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			Contractor Designed Bracing	1.2.4	G												

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	
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		16071	SD-01 Preconstruction Submittals														
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			SD-02 Shop Drawings														
			Connection Diagrams	1.3													
			Fabrication Drawings	1.3													
			Control Devices	3.1													
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			SD-03 Product Data														
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			Instrument Transformers	2.2													
			Enclosures	2.3													
			Circuit Breakers	2.4													
			Control Devices	3.1													
			Pushbuttons and Switches	2.6.4													
			Protective Relays	2.7													
			Indicating Lights	2.9													
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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	
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		16071	Combination Motor Controllers	2.1.2													
			Circuit Breakers	2.4													
			Pushbuttons and Switches	2.6.4													
			Protective Relays	2.7													
		16120	SD-03 Product Data														
			Manufacturer's Catalog	2.1.1	G												
			Installation Instructions	3.1													
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		16405	SD-01 Preconstruction Submittals														
			Terminal and Wire Designations	2.4.3.1	G												
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			Shop Test Plan	3.3.2	G												
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			As-Shipped Drawings	3.3.4	G												
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		16405	Pilot Devices	2.4.3	G												
			Manufacturer's Catalog Data	2.1	G												
			Material and Equipment List	2.2	G												
			SD-06 Test Reports														
			Shop Test Report	3.3.3	G												
			SD-08 Manufacturer's Instructions														
			Installation Procedures	3.1	G												
		16406	SD-01 Preconstruction Submittals														
			Field Test Plan	1.3.2	G												
			SD-02 Shop Drawings														
			Schedule of System I/O	2.4.3	G												
			SD-03 Product Data														
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			SD-06 Test Reports														
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			SD-08 Manufacturer's Instructions														
			Installation Procedures	3.1													
		16410	SD-02 Shop Drawings														
			Equipment	2.1													
			SD-03 Product Data														
			Material	2.1													
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			SD-06 Test Reports														
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		16410	SD-10 Operation and Maintenance														
			Data														
			Instructions	3.2													
		16436	SD-02 Shop Drawings														
			Contacts	2.2													
			Contacts	2.2													
			Indicating Lights	2.3													
			Indicating Lights	2.3													
			Terminal Board	2.4													
			Terminal Board	2.4													
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		16445	SD-02 Shop Drawings														
			Manual Transfer Switch	2.2.3													
			Manual Transfer Switch	2.2.3													
			Manual Transfer Switch	2.3													
			Manual Transfer Switch	2.3													
			Installation Drawings	3.1													
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			Equipment Foundation Data	1.2													
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		16905	SD-02 Shop Drawings														
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TITLE AND LOCATION

Robles Diversion Dam

CONTRACTOR

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## SECTION 01355A

## ENVIRONMENTAL PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM D 4439	(2004) Geosynthetics
ASTM D 4491	(1999; R 2004) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 2003) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D 5034	(2009) Breaking Strength and Elongation of Textile Fabrics (Grab Test)

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual
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## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions of Waters of the United States
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions

49 CFR 171 - 178

## Hazardous Materials Regulations

## 1.2 DEFINITIONS

## 1.2.1 Environmental Pollution and Damage

For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for but not limited to aesthetic, cultural and/or historical purposes.

## 1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

## 1.2.2.1 ENVIRONMENTAL PROTECTION REQUIREMENTS

These requirements are to provide and maintain, during the life of the contract, environmental protection. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project; and comply with Federal, State, and local regulations pertaining to the environment, including but not limited to water, air, and noise pollution; biological resources, transportation, recreation, public services and utilities; geology, seismicity and soils; hazardous materials and waste management. The Contractor will comply with all the requirements of the Environmental Protection Plan as described in this section.

## 1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

## 1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

#### 1.2.5 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

#### 1.2.6 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

#### 1.2.7 Wetlands

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

### 1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

### 1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors. Assurance of compliance with this section by subcontractors will be the responsibility of the Contractor and subject to disciplinary action and/or shut down until compliance is met.

### 1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

### 1.6 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

## Environmental Protection Plan; G

The environmental protection plan.

Species that require specific attention.

Species that require specific attention along with measures for their protection will be listed for all workers by the Contractor prior to beginning of construction operations.

## SD-07 Certificates

## Mill Certificate or Affidavit.

Certificate attesting that the Contractor has met all specified requirements.

## 1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan covering all mitigation measures contained herein for the protection of the environment as identified and discussed further in this section for review and approval by the Contracting Officer. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Contractor will meet with representatives of the Contracting Officer to develop a mutual understanding relative to compliance with this provision and administration of the environmental protection program. Construction and/or associated activities thereof will not commence until the environmental protection plan is approved by the Government. Approval of the Contractor's plan will not relieve the Contractor of his responsibility for adequate and continuous control of pollutants and other environmental protection measures. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. The Environmental Protection Plan shall be current and maintained onsite by the Contractor. The Government reserves the right to make changes in the Contractor's environmental protection plan and operations as necessary to maintain satisfactory environmental protection performance. The Government reserves the right to halt construction operations at the expense of the Contractor should the Contractor be found in non-compliance with the Environmental Protection plan approved by the Contracting Officer. Construction operations would resume when compliance is met. The environmental protection plan will include but not be limited to the following:

### 1.7.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

### 1.7.2 Contents

The Environmental Protection Plan shall include, but shall not be limited to, the following:

- a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.
- b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.
- c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
- d. Description of the Contractor's environmental protection personnel training program.
- e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.
- f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.
- g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.
- h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.
- i. Drawing showing the location of borrow areas.
- j. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:



1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer and the local Fire Department in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.
  2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.
  3. Training requirements for Contractor's personnel and methods of accomplishing the training.
  4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
  5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.
  6. The methods and procedures to be used for expeditious contaminant cleanup.
- k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July, and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted. The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor in addition to periodic monitoring by the U.S. Army Corps of Engineers Los Angeles District. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally-issued Clean Water Act permits.
1. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to

participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

m. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

n. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

o. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

p. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.

#### 1.7.3 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached, as an appendix, to the Environmental Protection Plan.

#### 1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately

following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

#### 1.9 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

#### 1.10 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection Plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

#### 1.11 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

##### 1.11.1 Stabilization Practices

The stabilization practices to be implemented shall include silt fences, straw bales, soil stabilizer, geotextiles, erosion control matts, etc. On his daily CQC Report, the Contractor shall record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, stabilization practices shall be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

##### 1.11.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after

construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

#### 1.11.1.2 No Activity for Less Than 21 Days

Where construction activity will resume on a portion of the site within 21 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 21 days), then stabilization practices do not have to be initiated on that portion of the site by the fourteenth day after construction activity temporarily ceased.

#### 1.11.2 Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices as necessary.

##### 1.11.2.1 Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Silt fences shall be installed in the locations indicated on the drawings. Final removal of silt fence barriers shall be upon approval by the Contracting Officer.

##### 1.11.2.2 Straw Bales

The Contractor shall provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. Bales shall be properly placed to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in a area between a ridge and drain, bales shall be placed as work progresses, bales shall be removed/replaced/relocated as needed for work to progress in the drainage area). Areas where straw bales are to be used shall be shown in the SWPPP. Final removal of straw bale barriers shall be upon approval by the Contracting Officer. Rows of bales of straw shall be provided as follows:

- a. Along the downhill perimeter edge of all areas disturbed.
- b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.
- c. Along the toe of all cut slopes and fill slopes of the construction areas.
- d. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc. that traverse disturbed areas or carry runoff from disturbed areas. Rows shall be spaced as shown in the SWPPP.

e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales. Rows shall be spaced as shown in the SWPPP.

f. At the entrance to culverts that receive runoff from disturbed areas.

#### 1.11.2.3 Diversion Dikes

Diversion dikes shall have a maximum channel slope of 2 percent and shall be adequately compacted to prevent failure. The minimum height measured from the top of the dike to the bottom of the channel shall be 20 inches. The minimum base width shall be 6 feet and the minimum top width shall be 2 feet. The Contractor shall ensure that the diversion dikes are not damaged by construction operations or traffic. Diversion dikes shall be located as shown in the SWPPP.

### PART 2 PRODUCTS

#### 2.1 COMPONENTS FOR SILT FENCES

##### 2.1.1 Filter Fabric

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

##### FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile	ASTM D 4632	100 lbs. min.
Elongation (%)	ASTM D 5034	30 % max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

##### 2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used, and shall have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

##### 2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll

identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

#### 2.1.4 Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D 4873.

#### 2.2 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, rice, or from grasses such as byhalia, bermuda, etc., furnished in air dry condition. The bales shall have a standard cross section of 14 inches by 18 inches. All bales shall be either wire-bound or string-tied. The Contractor may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 inches x 2 inches in cross section and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 3 feet.

### PART 3 EXECUTION

#### 3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

This paragraph supplements the Contractor's responsibility under the contract clause "PERMITS AND RESPONSIBILITIES" to the extent that the Government has obtained environmental permits. The Contractor shall comply with the terms and conditions of the attached list of environmental commitments at the end of this section.

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

##### 3.1.1 NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES), SWPPP AND NOI

A) In accordance with the United States National Pollution Discharge Elimination System (NPDES) Program / Statewide General Permit, the Contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP) in accordance with this Section and at least four weeks prior to the start of construction activities consisting of soil disturbing activities, the Contractor shall file a Notice of Intent with the site/vicinity map and appropriate fee to obtain coverage under the Statewide General Permit. The completed NOI form, site/vicinity map and appropriate fee must be mailed to the State Water Resources Control Board (SWRCB) at the following address:

State Water Resources Control Board  
Division of Water Quality  
ATTN: Storm Water Permit Unit  
P.O. Box 1977  
Sacramento, California 95812-1977  
ph (916) 341-5536/5537  
fax (916) 341-5543  
internet address: <http://www.swrcb.ca.gov/>

Overnight Mailing Address:

State Water Resources Control Board  
Division of Water Quality  
ATTN: Storm Water, 15th Floor  
1001 I Street  
Sacramento, California 95814

B) The NPDES / General Permit requires that a Storm Water Pollution Prevention Plan (SWPPP) shall be prepared and maintained on-site throughout the construction period. The processing of the NOI for the NPDES permit will require a minimum of 30 days. Construction work consisting of soil disturbing activities shall not begin without the SWRCB's receipt notification of the NOI.

C) Copies of the NOI forms, the site/vicinity map, and the SWRCB's receipt notification shall be provided to the U.S. Army Corps of Engineers Resident Office and the Environmental Resources Branch Ecosystems Planning Section, and the Contractor shall maintain a copy at the jobsite throughout the contract duration.

#### 3.1.1.1 Storm Water Pollution Prevention Plan (SWPPP)

The Contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP), including Best Management Practices (BMPs) and a detailed sediment erosion control, in accordance with this Section and provide a copy of the SWPPP, and any modifications to the SWPPP, to the State Water Resources Control Board, the Los Angeles Regional Water Quality Control Board and the U.S. Army Corps of Engineers Environmental Resources Branch Ecosystems Planning Section as well as concerned resources agencies, such as U. S. Fish and Wildlife Service, California Department of Fish and Game. A copy of the SWPPP, and any modifications to the SWPPP, shall be maintained at the jobsite throughout the contract duration. A copy of the NOI shall be provided to the Los Angeles RWQCB. The Contractor shall follow conditions identified in the NPDES permit/SWPPP to eliminate discharge of pollutants within the waters of the United States.

The Los Angeles Regional Water Quality Control Board address is:  
Los Angeles Regional Water Quality Control Board  
320 W. 4th Street, Suite 200  
Los Angeles, CA 90013  
ph (213) 576-6600  
fax (213) 576-6640

#### 3.1.1.2 Modifications to SWPPP

If the SWRCB or RWQCB requires modifications prior to or during the construction phase, the plan(s) shall include the use of settling basins, hay bales, and silt fences (or other appropriate measures) for any surface water diversion and groundwater (subsurface water) dewatering activities within the project site or work within any flowing streams. This plan shall also include stormwater pollution prevention measures specific to this project, such as protection of exposed slopes/banks, access routes, and temporary onsite stockpiles of excavated materials. A final water diversion plan, including structure configuration, location, construction materials, equipment, operation procedures, erosion and sediment control measures shall be included.

#### 3.1.2 Section 401 Water Quality Certification

The Government will request a Section 401 Water Quality Certification (WQC)

permit from the California Regional Water Quality Control Board. Conditions identified in the Section 401 WQC permit shall be followed by the construction Contractor. The contractor shall obtain a copy of the Section 401 WQC permit. The Contractor shall coordinate with the Environmental Coordinator of the COE's Environmental Resources Branch, (Chris Jones, Ecosystem Planning Section, phone: (213) 304-6234, Christopher.T.Jones@usace.army.mil), for the clarification or application of the conditions identified in the Section 401 WQC permit.

### 3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

#### 3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

#### 3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

#### 3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as specified in Paragraph EROSION AND SEDIMENT CONTROL FACILITIES. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. The Contractor's best management practices shall also



be in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Pollution Prevention Plan (SWPPP) which may be reviewed at the Environmental Office. Any temporary measures shall be removed after the area has been stabilized.

#### 3.2.4 Unprotected Erodible Soils

Earthwork brought to final grade shall be finished as indicated. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Except in cases where the constructed feature obscures borrow areas, quarries, and waste material areas, these areas shall not initially be totally cleared. Clearing of such areas shall progress in reasonably sized increments as needed to use the developed areas as approved by the Contracting Officer.

#### 3.2.5 Disturbed Areas

The Contractor shall effectively prevent erosion and control sedimentation through approved methods including, but not limited to, the following:

- a. Retardation and control of runoff. Runoff from the construction site or from storms shall be controlled, retarded, and diverted to protected drainage courses by means of diversion ditches, benches, berms, and by any measures required by area wide plans under the Clean Water Act.

#### 3.2.6 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

### 3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

- a. The contractor shall employ conditions identified in the Best Management Practices (BMPs) manual during and after construction to minimize erosion and runoff from construction activities. The BMPs are expected to include:
  1. Use of controlled construction staging and entrance areas to minimize ground disturbance and contaminated runoff;
  2. Installation of silt fences where appropriate at the toe of slopes to prevent sloughing of materials into the channel.

b. Measures to reduce turbidity during project construction and periodic future maintenance would include the installation of pipe, as needed, as well as creation of low-flow channels around construction and debris removal of operations to divert water flow and avoid mixing of loose dust particles into river flow:

1. Silt fencing, hay bales, sand bags and/or the construction of silt catchment basins will be placed downstream of any operation which may create turbidity. Such devices will reduce turbidity to that level existing upstream of the clean out activities.

c. Strict construction site rules for handling hazardous materials will be implemented to prevent spills and provide controlled storage away from the river. Petroleum products, concrete, asphalt or other coating materials, and other hazardous materials will be prevented from contaminating soil or entering surface waters.

d. Preparations will be made so that runoff from steep, erodible surfaces will be directed into stable areas with minimal erosion potential.

e. Water containing mud, silt, or other pollutants from aggregate washing or other activities will not enter the river.

f. Stationary equipment such as motors located within or adjacent to the river will be positioned over drip pans.

g. Any equipment or vehicles driven and/or operated within or adjacent to the river will be properly maintained to minimize leaks.

h. Corps' Environmental Resources Branch personnel will monitor construction records and activities to ensure compliance with water quality requirements.

i. The contractor shall implement erosion and sediment control measures in the project area and upstream of the project limits to prevent sloughing of materials into the flood control channel during construction.

j. Project plans and specifications will incorporate standards from current seismic codes.

### 3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering, removal of cofferdams and tailrace excavation shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State of California water quality standards and anti-degradation provisions. The Contractor will plan his operations and perform all work necessary to minimize adverse impact or violation of the water quality standard for the State of California.

The Contractor will submit to the Contracting Officer for review and approval a map identifying the location of proposed dewatering operations, and the proposed method of dewatering operations.

### 3.3.2 Stream Crossings

Stream crossings will be controlled during construction. Stream crossings

shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments.

### 3.3.3 Wetlands

The Contractor shall not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

### 3.3.4 Street Sweeping

At the close of each working day, any materials as a result of construction activities, such as dirt, tracked into the adjacent streets (streets for construction access and hauling of materials) or laying uncontained in the construction areas are to be swept up. A log of street sweeping activities will be maintained and submitted monthly for compliance. See Monthly Logs.

## 3.4 AIR RESOURCES

Equipment operation and activities or processes performed by the Contractor in accomplishing the specified construction shall be in accordance with the State's rules and all Federal emission and performance laws and standards. The Contractor shall obtain and comply with Air Quality Permits. Ambient Air Quality Standards set by the Environmental Protection Agency shall be maintained. Monitoring of air quality shall be monitored by Environmental Resources Branch and contracted to implement all pertinent environmental regulations and measures including, if applicable, Section 176 (c) of the Clean Air Act conformity determination. All air areas affected by the construction activities shall be monitored by the Contractor. Monitoring results will be periodically reviewed by the Government to ensure compliance.

Special management techniques as set out below shall be implemented to control air pollution by the construction activities. These techniques supplement the requirements of Federal, State, and local laws and regulations; and the safety requirements under this Contract. If any of the following techniques conflict with the requirements of Federal, State, or local laws or regulations, or safety requirements under this contract, then those requirements shall be followed in lieu of the following.

- a. To reduce fugitive dust, the stockpile material and unpaved roads will be watered as necessary to prevent wind-generated pollution.
- b. When wind speeds exceed 20 miles per hour, excavation and grading operations will be suspended.
- c. Truck speeds on unpaved roads will not exceed 15 miles per hour.
- d. Where feasible, the construction Contractor will use electric power from poles.
- e. Idling time of trucks and other construction equipment will be minimized.
- f. Contractors will perform excavation, grading, materials handling, and hauling of materials in compliance with SCAQMD Rule 403, Fugitive Dust. Specific measures to be included in the specifications will address the maintenance of adequate moisture content in soils to be excavated and transported; the stabilization of exposed graded areas; the cleaning of paved roads to be used as haul roads; paving or

alternate treatment of unpaved roads considered for haul roads; and prevention of soil track-out from construction areas onto paved roads. The construction Contractor will be responsible for obtaining applicable air quality permits.

g. All trucks hauling materials subject to wind dispersal will be watered and covered.

h. All disturbed soil areas not subject to revegetation will be stabilized with approved nontoxic soil binders, jute netting, or other methods, as appropriate.

#### 3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

##### 3.4.1.1 Other Air Pollutants

All construction equipment and trucks shall have their engines kept in a state of tune that will minimize all exhaust pollutants, and shall use fuel of a quality that does not produce excessive amounts of exhaust plumes. Methods to reduce No levels may include the following measures:

- a. Require injection timing retard of 2 degrees on all diesel vehicles where applicable.
- b. Install high-pressure injectors on all vehicles, where feasible.
- c. Use Caterpillar pre-chamber diesel engines or equivalent, and perform proper maintenance and operation.
- d. Electrify equipment, where feasible.
- e. Maintain equipment in tune with manufacturers' specifications, except as otherwise stated above.
- f. Restrict the driling of construction equipment to 10 minutes.
- g. Install catalytic converters on gasoline-powered equipment.
- h. Substitute gasoline-powered for diesel-powered equipment, where feasible.

### 3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

### 3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environmental damage by noise.

### 3.4.4 Burning

Burning shall be prohibited on the Government premises.

## 3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

### 3.5.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

### 3.5.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

### 3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department

of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

- a. Emergency provisions to contain and clean up unintentional spills will be in place prior to the construction.
- b. Measures will be followed to avoid accidental spills of oil and grease during construction and debris removal operations. If such spills occur, the Contractor will be required clean up the affected area immediately and remove materials from the site.
- c. If a contaminated area is encountered during construction, construction will cease in the vicinity of the contaminated area. The Contractor will perform an assessment to determine the extent and type of contamination. If necessary, the contaminated site will be remediated to minimize the potential for exposure of the public and to allow the project to be constructed safely. All appropriate authorities (including EPA and the Corps) will be notified.
- d. The Contractor will comply with existing regulatory requirements regarding worker safety.

#### 3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site shall be accordance with all Federal, State, and local laws and regulations.

#### 3.5.5 Waste Water

Disposal of waste water shall be as specified below.

- a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water in accordance with all Federal, State, Regional and Local laws and regulations.
- b. For discharge of ground water, the Contractor shall surface discharge in accordance with the requirements of the NPDES or State STORM WATER DISCHARGES FROM CONSTRUCTION SITES permit.
- c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing shall be discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator.

### 3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

### 3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall submit a report to the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. The following shall be included in the report:

a. Construction and Demolition (C&D) Debris Disposed = \_\_\_\_\_ in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled = \_\_\_\_\_ in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated = \_\_\_\_\_ in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = \_\_\_\_\_ in cubic yards or tons, as appropriate.

### 3.8 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

a. A qualified archeologist monitor will be on site during heavy equipment activity adjacent to historic structures to ensure avoidance of identified historic resources. The Contractor shall contact Stephen Dibble, senior archeologist, (213) 452-3849 to coordinate monitoring activities.

b. In the event that previously unknown historic or archeological features or deposits are observed by the contractor during the course of operations, work shall cease in that area, and the construction representative shall be immediately informed.

### 3.9 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

### 3.10 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

### 3.11 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

### 3.12 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

### 3.13 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

### 3.14 EROSION AND SEDIMENT CONTROL FACILITIES

#### 3.14.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 16 inches above the ground surface and shall not exceed 34 inches above the ground surface. Filter fabric shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 4 inches wide



and 4 inches deep on the upslope side of the location of the silt fence. The 4-inch by 4-inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

#### 3.14.2 INSTALLATION OF STRAW BALES

Straw bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier. Loose straw shall be scattered over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

#### 3.14.3 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

##### 3.14.3.1 Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade.

##### 3.14.3.2 Straw Bale Maintenance

Straw bale barriers shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales. Necessary repairs to barriers or replacement of bales shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the barrier. Bale rows used to retain sediment shall be turned uphill at each end of each row. When a straw bale barrier is no longer required, it shall be removed. The immediate area occupied by the bales and any sediment deposits shall be shaped to an acceptable grade.

### 3.14.3.3 Diversion Dike Maintenance

Diversion dikes shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged diversion dikes and necessary repairs shall be accomplished promptly. When diversion dikes are no longer required, they shall be shaped to an acceptable grade.

### 3.14.4 INSPECTIONS

#### 3.14.4.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

#### 3.14.4.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

#### 3.14.4.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

## SECTION 01356A

## STORM WATER POLLUTION PREVENTION MEASURES

## 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 within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM D 4439	(2004) Geosynthetics
ASTM D 4491	(1999; R 2004) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 2003) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

## 1.2 GENERAL REQUIREMENTS

Contractor shall implement the storm water pollution prevention measures to prevent sediment from entering streams or water bodies as specified in this Section in conformance with the requirements of Section 01355A ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit.

## 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-07 Certificates

## Mill Certificate or Affidavit

Certificate attesting that the Contractor has met all specified requirements.

#### 1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

##### 1.4.1 Stabilization Practices

The stabilization practices to be implemented shall include temporary seeding, mulching, geotextiles, protection of trees, preservation of mature vegetation, etc. On his daily CQC Report, the Contractor shall record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, stabilization practices shall be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

###### 1.4.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

###### 1.4.1.2 No Activity for Less Than 21 Days

When the total time period in which construction activity is temporarily ceased on a portion of the site is 21 days minimum, stabilization practices do not have to be initiated on that portion of the site until 14 days have elapsed after construction activity temporarily ceased.

##### 1.4.2 Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices.

###### 1.4.2.1 Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Silt fences shall be installed in the locations indicated on the drawings. Final removal of silt fence barriers shall be upon approval by the Contracting Officer.

###### 1.4.2.2 Diversion Dikes

Diversion dikes shall have a maximum channel slope of 2 percent and shall be adequately compacted to prevent failure. The minimum height measured from the top of the dike to the bottom of the channel shall be 18 inches. The minimum base width shall be 6 feet and the minimum top width shall be 2 feet. The Contractor shall ensure that the diversion dikes are not damaged

by construction operations or traffic. Diversion dikes shall be located as shown on the drawings.

## PART 2 PRODUCTS

### 2.1 COMPONENTS FOR SILT FENCES

#### 2.1.1 Filter Fabric

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

#### FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile	ASTM D 4632	100 lbs. min.
Elongation (%)		30 % max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

#### 2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 by 2 inches when oak is used and 4 by 4 inches when pine is used, and shall have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds/linear foot and a minimum length of 5 feet.

#### 2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

#### 2.1.4 Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D 4873.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 16 inches above the ground surface and shall not exceed 34 inches above the ground surface. Filter fabric shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4 by 4 inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

### 3.2 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

#### 3.2.1 Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall receive erosion control.

#### 3.2.2 Diversion Dike Maintenance

Diversion dikes shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged diversion dikes and necessary repairs shall be accomplished promptly. When diversion dikes are no longer required, they shall be shaped to an acceptable grade.

### 3.3 INSPECTIONS

#### 3.3.1 General

The Contractor shall inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

### 3.3.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

### 3.3.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

### 3.3.4 Monthly Inspection Report and Certification Form for Erosion and Sediment Controls

On the first working day of each month the Contractor shall complete, sign, and submit the original form to the California State Water Resources Control Board at the following address:

State Water Resources Control Board  
1001 I Street  
Sacramento, CA 95814

On the first working day of each month the Contractor shall submit and furnish one copy of the inspection report and certification form to the California State Water Resources Control Board to the Contracting Officer as part of the Contractor's daily CQC Report and attach a copy of the completed form to the Plan. Unless otherwise notified by the California State Water Resources Control Board, the Contractor shall submit the Monthly Inspection Report and Certification Forms for an additional two months after the final completion of all storm water pollution prevention measures required in this contract have been implemented.

-- End of Section --

## SECTION 01420

## SOURCES FOR REFERENCE PUBLICATIONS

## 1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

## 1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)  
P.O. Box 9094  
Farmington Hills, MI 48333-9094  
Ph: 248-848-3700  
Fax: 248-848-3701  
E-mail: [bkstore@concrete.org](mailto:bkstore@concrete.org)  
Internet: <http://www.aci-int.org>

ALUMINUM ASSOCIATION (AA)  
900 19th Street N.W., Suite 300  
Washington, DC 20006  
Ph: 202-862-5100  
Fax: 202-862-5164  
Internet: <http://www.aluminum.org>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)  
444 North Capital Street, NW, Suite 249  
Washington, DC 20001  
Ph: 202-624-5800  
Fax: 202-624-5806  
E-Mail: [info@ashto.org](mailto:info@ashto.org)  
Internet: <http://www.aashto.org>

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)  
2025 M Street, NW, Suite 800  
Washington, DC 20036  
Ph: 202-367-1155  
Fax: 202-367-2155  
E-mail: [info.abma@smithbucklin.com](mailto:info.abma@smithbucklin.com)  
Internet: <http://www.abma-dc.org>



AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)  
500 Montgomery Street, Suite 300  
Alexandria, VA 22314-1560  
Ph: 703-684-0211  
Fax: 703-684-0242  
E-mail: [webmaster@agma.org](mailto:webmaster@agma.org)  
Internet: <http://www.agma.org>

AMERICAN HARDBOARD ASSOCIATION (AHA)  
c/o Composite Panel Association  
18922 Premiere Court  
Gaithersburg, MD 20879-1574  
Ph: 301-670-0604  
Fax: 301-840-1252  
Internet: <http://www.pbmdf.org>

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)  
One East Wacker Drive, Suite 3100  
Chicago, IL 60601-2001  
Ph: 312-670-2400  
Fax: 312-670-5403  
Publications: 800-644-2400  
E-mail: [pubs@aisc.org](mailto:pubs@aisc.org)  
Internet: <http://www.aisc.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)  
1819 L Street, NW, 6th Floor  
Washington, DC 20036  
Ph: 202-293-8020  
Fax: 202-293-9287  
E-mail: [info@ansi.org](mailto:info@ansi.org)  
Internet: <http://www.ansi.org/>

--- ANSI documents beginning with the letter "S" can be ordered from:

Acoustical Society of America (ASA)  
2 Huntington Quadrangle, Suite 1N01  
Melville, NY 11747-4502  
Ph: 516-576-2360  
Fax: 516-576-2377  
E-mail: [asa@aip.org](mailto:asa@aip.org)  
Internet: <http://asa.aip.org>

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)  
1711 Arlingate Lane  
P.O. Box 28518  
Columbus, OH 43228-0518  
Ph: 800-222-2768; 614-274-6003  
Fax: 614-274-6899  
E-mail: [webmaster@asnt.org](mailto:webmaster@asnt.org)  
Internet: <http://www.asnt.org>

AMERICAN WELDING SOCIETY (AWS)  
550 N.W. LeJeune Road  
Miami, FL 33126  
Ph: 800-443-9353 - 305-443-9353

Fax: 305-443-7559  
E-mail: [info@aws.org](mailto:info@aws.org)  
Internet: <http://www.aws.org>

ASME INTERNATIONAL (ASME)  
Three Park Avenue  
New York, NY 10016-5990  
Ph: 212-591-7722  
Fax: 212-591-7674  
E-mail: [infocentral@asme.org](mailto:infocentral@asme.org)  
Internet: <http://www.asme.org>

ASTM INTERNATIONAL (ASTM)  
100 Barr Harbor Drive, P.O. Box C700  
West Conshohocken, PA 19428-2959  
Ph: 610-832-9500  
Fax: 610-832-9555  
E-mail: [service@astm.org](mailto:service@astm.org)  
Internet: <http://www.astm.org>

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)  
933 North Plum Grove Road  
Schaumburg, IL 60173-4758  
Ph: 847-517-1200  
Fax: 847-517-1206  
Internet: <http://www.crsi.org/>

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)  
8720 Red Oak Boulevard, Suite 201  
Charlotte, NC 28217-3992  
Ph: 704-676-1190  
Fax: 704-676-1199  
Internet: <http://www.mhia.org/>

ELECTRONIC INDUSTRIES ALLIANCE (EIA)  
2500 Wilson Boulevard  
Arlington, VA 22201-3834  
Ph: 703-907-7500  
Fax: 703-907-7501  
Internet: <http://www.eia.org>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)  
445 Hoes Lane  
Piscataway, NJ 08855-1331  
Ph: 732-981-0060  
Fax: 732-981-1712  
E-mail: [customer-services@ieee.org](mailto:customer-services@ieee.org)  
Internet: <http://www.ieee.org>

INTERNATIONAL CODE COUNCIL (ICC)  
5203 Leesburg Pike, Suite 600  
Falls Church, VA 22041  
Ph: 703-931-4533  
Fax: 703-379-1546  
E-mail: [webmaster@iccsafe.org](mailto:webmaster@iccsafe.org)  
Internet: <http://www.intlcode.org>

MASTER PAINTERS INSTITUTE (MPI)  
4090 Graveley Street

Burnaby, BC CANADA V5C 3T6  
Ph: 888-674-8937  
Fax: 888-211-8708  
E-mail: [info@paintinfo.com](mailto:info@paintinfo.com)  
Internet: <http://www.paintinfo.com/mpi>

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)  
8 South Michigan Avenue, Suite 1000  
Chicago, IL 60603  
Ph: 312-322-0405  
Fax: 312-332-0706  
E-mail: [naamm@gss.net](mailto:naamm@gss.net)  
Internet: [ht  
tp://www.naamm.org](http://www.naamm.org)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)  
1300 North 17th Street, Suite 1847  
Rosslyn, VA 22209  
Ph: 703-841-3200  
Fax: 703-841-5900  
E-mail: [webmaster@nema.org](mailto:webmaster@nema.org)  
Internet: <http://www.nema.org/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)  
1 Batterymarch Park  
Quincy, MA 02169-7471  
Ph: 617-770-3000  
Fax: 617-770-0700  
E-mail: [webmaster@nfpa.org](mailto:webmaster@nfpa.org)  
Internet: <http://www.nfpa.org>

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)  
Mail Stop C-13  
4676 Columbia Parkway  
Cincinnati, OH 45226-1998  
Ph: 800-356-4674  
Fax: 513-533-8573  
E-mail: [pubstaff@cdc.gov](mailto:pubstaff@cdc.gov)  
Internet: <http://www.cdc.gov/niosh/homepage.html>

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)  
100 Bureau Drive  
Stop 3460  
Gaithersburg, MD 20899-3460  
Ph: 301-975-NIST  
Internet: <http://www.nist.gov>  
Order Publications From:  
Superintendent of Documents  
U.S. Government Printing Office (GPO)  
732 North Capitol Street, NW  
Washington, DC 20401  
Ph: 888-293-6498 or 202-512-1530  
Fax: 202-512-1262  
E-mail: [gpoaccess@gpo.gov](mailto:gpoaccess@gpo.gov)  
Internet: <http://www.gpoaccess.gov>  
or  
National Technical Information Service (NTIS)  
5285 Port Royal Road  
Springfield, VA 22161

Ph: 703-605-6585  
Fax: 703-605-6900  
E-mail: [info@ntis.gov](mailto:info@ntis.gov)  
Internet: <http://www.ntis.gov>

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)  
900 Spring Street  
Silver Spring, MD 20910  
Ph: 301-587-1400  
Fax: 301-585-4219  
Internet: <http://www.nrmca.org>

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)  
Publication Distribution Unit  
1900 Royal Oaks Dr.  
Sacramento, CA 95815-3800  
Ph: 916-445-3520  
Fax: 916-324-8997  
E-mail: [publications@dot.ca.gov](mailto:publications@dot.ca.gov)  
Internet: <http://www.dot.ca.gov>

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)  
40 24th Street, 6th Floor  
Pittsburgh, PA 15222-4656  
Ph: 412-281-2331  
Fax: 412-281-9992  
E-mail: [info@sspc.org](mailto:info@sspc.org)  
Internet: <http://www.sspc.org>

UNDERWRITERS LABORATORIES (UL)  
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Northbrook, IL 60062-2096  
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-- End of Section --

## SECTION 01451

## CONTRACTOR QUALITY CONTROL

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM D 3740	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

## 1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

## 3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.



### 3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

#### 3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.
- b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.
- c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.
- d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.
- e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. Laboratory facilities will be approved by the Contracting Officer.
- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.
- g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified

deficiencies have been corrected.

- h. Reporting procedures, including proposed reporting formats.
- i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

### 3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

### 3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

## 3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 5 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

## 3.4 QUALITY CONTROL ORGANIZATION

### 3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The

Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, show drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

#### 3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 10 years construction experience on construction similar to this contract. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

#### 3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: electrical, mechanical, civil, structural, environmental, architectural, materials technician, and submittals clerk. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan.

Experience Matrix

	Area	Qualifications
a.	Civil	Graduate Civil Engineer with 5 years experience in the type of work being performed on this project or technician with 10 yrs related experience
b.	Mechanical	Graduate Mechanical Engineer with 5 yrs experience or person with 10 yrs related experience
c.	Electrical	Graduate Electrical

## Experience Matrix

	Area	Qualifications
		Engineer with 5 yrs related experience or person with 10 yrs related experience
d.	Structural	Graduate Structural Engineer with 5 yrs experience or person with 10 yrs related experience
e.	Architectural	Graduate Architect with 5 yrs experience or person with 10 yrs related experience
f.	Environmental	Graduate Environmental Engineer with 5 yrs experience
g.	Submittals	Submittal Clerk with 2 yrs experience
h.	Concrete, Pavements and Soils	Materials Technician with 5 yrs experience for the appropriate area
i.	Testing, Adjusting and Balancing (TAB) Personnel	Specialist must be a member of AABC or an experienced technician of the firm certified by the NEBB.

## 3.4.4 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

## 3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

## 3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

## 3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable

feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

- a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.
- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
- g. A review of the appropriate activity hazard analysis to assure safety requirements are met.
- h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
- i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
- j. Discussion of the initial control phase.
- k. The Government shall be notified at least 72 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

### 3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

- a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

- b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.
- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- f. The Government shall be notified at least 72 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
- g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

### 3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

### 3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

## 3.7 TESTS

### 3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.

- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

### 3.7.2 Testing Laboratories

#### 3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

#### 3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$500 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

#### 3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

#### 3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, f.o.b., at the following address:

U.S. Army Engineers  
Waterways Experiment Station  
3909 Halls Ferry Road  
Vicksburg, MS 39180-6199

Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

### 3.8 COMPLETION INSPECTION

#### 3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the Special Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

#### 3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

#### 3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

### 3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and



shall be on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.
- g. Offsite surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

### 3.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order

stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

## SECTION 01702

## AS-BUILT DRAWINGS

## 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.

U.S. ARMY RESEARCH, DEVELOPMENT, AND ENGINEERING COMMAND (EA)

ERDC/ITL TR-01-6

(2001) A/E/C Cadd Standard

## 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-11 Closeout Submittals

Submittal of the As-Built Field Data; G

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

## 3.1 AS-BUILT FIELD DATA

## 3.1.1 General

The Contractor shall prepare and furnish the as-built drawings for the project. The as-built drawings shall be a record of the construction as installed and completed by the Contractor. They shall include all the information shown on the contract set of drawings and a record of all deviations, modifications, or changes from those drawings, however minor, which were incorporated in the work, all additional work not appearing on the contract drawings, and all changes which are made after final inspection of the contract work. In event the Contractor accomplishes additional work which changes the as-built conditions of the facility after submission of the as-built drawings, the Contractor shall furnish revised and/or additional drawings as required to depict as-built conditions. The requirements for these additional drawings will be the same as for the as-built drawings included in the original submission. The drawings shall show the following information, but not be limited thereto:

(a) The location and description of any utility lines or other installations of any kind or description known to exist within the construction area. The location includes dimensions to permanent

features.

(b) The location and dimensions of any changes within the building or structures.

(c) Correct grade or alignment of dam embankment, roads, channels, structures or utilities if any changes were made from contract plans.

(d) Correct elevations if changes were made in site grading or placement of materials in the dam embankment.

(e) Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, dimensions of equipment foundations, etc.

(f) The topography and grades of all drainage installed or affected as a part of the project construction.

(g) All changes or modifications which result from the final inspection.

(h) Where contract drawings or specifications allow options, only the option actually used in the construction shall be shown on the as-built drawings. The option not used shall be deleted.

### 3.1.2 Preliminary As-Built Drawings

The Contractor shall maintain one (1) set of full size, blue-line prints marked up in red to show the as-built conditions. This set of as-built prints shall be kept current and available at the job site at all times. All changes from what is shown on the contract plans, whether it be from changes requested by the Contracting Officer or resulting from additional information which might be uncovered in the course of construction, shall be accurately and neatly recorded as they occur by means of details and notes. The marked-up as-built prints will be jointly inspected for accuracy and completeness by the Contracting Officer and Contractor prior to submission of each monthly pay estimate. Failure to keep the As-Built Field Data current shall be sufficient justification to withhold a retained percentage from the monthly pay estimate. Information to be included on these preliminary drawings shall conform to the requirements as stated above. Any and all as-built modifications shall be reflected on all sheets affected by the modifications.

#### 3.1.2.1 Submittal of the As-Built Field Data

One (1) full size set of marked up drawings with the as-built field data shall be submitted to the Contracting Officer for review and approval a minimum of 20 calendar days prior to the date of final inspection. If review of the preliminary as-built drawings reveals errors and/or omissions, the drawings will be returned to the Contractor for corrections. The Contractor shall make all corrections and return the drawings to the Contracting Officer within 10 calendar days of receipt.

### 3.2 AS-BUILT ELECTRONIC FILE DRAWINGS

#### 3.2.1 General

No later than 30 days after final acceptance a complete set of as-built drawings shall be submitted in Intergraph MicroStation electronic file format. The as-built drawings shall be done in a quality equal to that of the originals. Line work, line weights, and lettering, and use of symbols shall be the same as the original line work, line weights, and lettering, and symbols. If additional drawings are required they shall be prepared in electronic file format under the same guidance. When final revisions have been completed, each drawings shall be identified with the words "AS-BUILT" in block letters at least 3/8-inch high placed above the title block if space permits, or if not, below the title block between the border and the trim line. The date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the latest revision notation.

#### 3.2.2 Original Files

Upon Contractor's request the Government will provide the Contractor one set of Intergraph MicroStation electronic file format contract drawings, to be used for as-built drawings. The electronic file drawings will be available on CD-ROM media, or an 8-mm data cartridge (Contractor's choice).

#### 3.2.3 Electronic File Submittal Requirements

##### 3.2.3.1 File Submittals

The MicroStation electronic file(s) deliverable shall be in MicroStation version 5.0 'DGN' binary format. All support files required to display or plot the file(s) in the same manner as they were developed shall be delivered along with the files. These files include but are not limited to Font Libraries, Pen Tables, and Referenced files.

##### 3.2.3.2 Drawing Format

Layering shall be performed in accordance with the Tri-Service CADD/GIS Technology Center's Architectural, Engineering and Construction (A/E/C) CADD Standards manual, ERDC/ITL TR-01-6, version 2.0. An explanatory list of which layer is used at which drawing and an explanatory list of all layers which do not conform to the guidelines shall be provided with each submittal.

##### 3.2.3.3 Electronic File Deliverable Media

All electronic files shall be submitted on CD-ROM media. Two complete sets of disks shall be submitted along with one complete set of prints taken from the disks. The electronic files shall be delivered on ISO 9660 format CD-ROM media. Due to the limited ability to mark on CD-ROM media, only the Contractor's firm name, project name and location, submittal type (AS-BUILT) and date will be required. Each submittal shall be accompanied by a hard copy transmittal sheet that contains the above information along with a description of each file provided in the submittal.

### 3.3 FINAL AS-BUILT DRAWINGS

The final as-built record drawings shall be completed and returned together with the approved preliminary as-built drawings to the Contracting Officer within 30 calendar days of final acceptance. The Contracting Officer will

review all final as-built record drawings for accuracy and conformance to the drafting standards and other requirements contained in DIVISION 1 GENERAL REQUIREMENTS. The drawings shall be returned to the Contractor if corrections are necessary. The Contractor shall make all corrections and shall return the drawings to the Contracting Officer within 7 calendar days of receipt. Upon final approval, the Contractor shall furnish two (2) full size sets and two (2) half size sets of the final as-built plans, and the electronic as-built project files in Microstation and PDF format. All project files, whether revised or not, shall be provided to the Contracting Officer.

-- End of Section --

## SECTION 01780

## CLOSEOUT SUBMITTALS

## PART 1 GENERAL

## 1.1 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

## As-Built Drawings; G

Drawings showing final as-built conditions of the project.

## SD-03 Product Data

## As-Built Record of Equipment and Materials

Records listing the as-built materials and equipment incorporated into the construction of the project.

## Warranty Management Plan

Two sets of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

## Warranty Tags

Two record copies of the warranty tags showing the layout and design.

## Final Cleaning

Two copies of the listing of completed final clean-up items.

## 1.2 PROJECT RECORD DOCUMENTS

## 1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

#### 1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

#### 1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

- a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.
- b. The location and dimensions of any changes within the building structure.
- c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.
- d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.
- e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.
- f. Changes or modifications which result from the final inspection.



g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Circle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

(4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).

(5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

#### 1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

#### 1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as

the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards used for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The electronic files in MicroStation J format will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

- (1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.
- (2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.
- (3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing. Special notes shall be in blue on layer #63.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 20 days after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 10 days the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 20 days of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The Contractor shall furnish two (2) full size sets and two (2) half size sets of the final as-built hardcopy plans, one (1) set of full-size electronic as-built project files in Microstation and PDF format and one (1) set of the approved working As-Built Drawings. The electronic submittal shall consist of three set of electronic files on compact disc, read-only memory (CD-ROM).

They shall be complete in all details and identical in form and function

to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

#### 1.2.2 As-Built Record of Equipment and Materials

The Contractor shall furnish two copies of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Four hard copies and three electronic copies of final record of equipment and materials shall be submitted 10 days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

##### RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, performance specification, Model, and Serial Number	Composition and Size	Where Used
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#### 1.2.3 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

#### 1.2.4 Construction Contract Specifications

The Contractor shall furnish final as-built construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

#### 1.2.5 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

### 1.3 WARRANTY MANAGEMENT

#### 1.3.1 Warranty Management Plan

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.

9. Summary of maintenance procedures required to continue the warranty in force.

10. Cross-reference to specific pertinent Operation and Maintenance manuals.

11. Organization, names and phone numbers of persons to call for warranty service.

12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

#### 1.3.2 Performance Bond

The Contractor's Performance Bond shall remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

#### 1.3.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the

warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

#### 1.3.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

- a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.
- b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.
- c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.
- d. The "Construction Warranty Service Priority List" is as follows:

##### Code 1-Air Conditioning Systems

- (1) Recreational support.
- (2) Air conditioning leak in part of building, if causing damage.
- (3) Air conditioning system not cooling properly.

##### Code 1-Doors

- (1) Overhead doors not operational, causing a security, fire, or safety problem.
- (2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

##### Code 3-Doors

- (1) Overhead doors not operational.
- (2) Interior/exterior personnel doors or hardware not functioning properly.

##### Code 1-Electrical

- (1) Power failure (entire area or any building operational after 1600 hours).
- (2) Security lights
- (3) Smoke detectors

##### Code 2-Electrical

- (1) Power failure (no power to a room or part of building).
- (2) Receptacle and lights (in a room or part of building).

##### Code 3-Electrical

Street lights.

## Code 1-Gas

- (1) Leaks and breaks.
- (2) No gas to family housing unit or cantonment area.

## Code 1-Heat

- (1). Area power failure affecting heat.
- (2). Heater in unit not working.

## Code 2-Kitchen Equipment

- (1) Dishwasher not operating properly.
- (2) All other equipment hampering preparation of a meal.

## Code 1-Plumbing

- (1) Hot water heater failure.
- (2) Leaking water supply pipes.

## Code 2-Plumbing

- (1) Flush valves not operating properly.
- (2) Fixture drain, supply line to commode, or any water pipe leaking.
- (3) Commode leaking at base.

## Code 3 -Plumbing

Leaky faucets.

## Code 3-Interior

- (1) Floors damaged.
- (2) Paint chipping or peeling.
- (3) Casework.

## Code 1-Roof Leaks

Temporary repairs will be made where major damage to property is occurring.

## Code 2-Roof Leaks

Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

## Code 2-Water (Exterior)

No water to facility.

## Code 2-Water (Hot)

No hot water in portion of building listed.

Code 3-All other work not listed above.

## 1.3.5 Warranty Tags

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

- a. Type of product/material\_\_\_\_\_.

- b. Model number\_\_\_\_\_.
- c. Serial number\_\_\_\_\_.
- d. Contract number\_\_\_\_\_.
- e. Warranty period\_\_\_\_\_from\_\_\_\_\_to\_\_\_\_\_.
- f. Inspector's signature\_\_\_\_\_.
- g. Construction Contractor\_\_\_\_\_.
- Address\_\_\_\_\_.
- Telephone number\_\_\_\_\_.
- h. Warranty contact\_\_\_\_\_.
- Address\_\_\_\_\_.
- Telephone number\_\_\_\_\_.
- i. Warranty response time priority code\_\_\_\_\_.
- j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

#### 1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Contracting Officer as specified in applicable technical specification sections.

#### 1.5 OPERATION AND MAINTENANCE MANUALS

Operation manuals and maintenance manuals shall be submitted as specified. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed.

#### 1.6 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be replaced. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.



PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

## SECTION 01781

## OPERATION AND MAINTENANCE DATA

## PART 1 GENERAL

## 1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01330 SUBMITTAL PROCEDURES.

## 1.1.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

## 1.1.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission.

## 1.1.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

## 1.2 TYPES OF INFORMATION REQUIRED IN O&amp;M DATA PACKAGES

## 1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

## 1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

## 1.2.1.2 Operator Prestart

Include procedures required to set up and prepare each system for use.

## 1.2.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

#### 1.2.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

#### 1.2.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

#### 1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

#### 1.2.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

#### 1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

##### 1.2.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

##### 1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

### 1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

#### 1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

#### 1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

#### 1.2.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

#### 1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

#### 1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

### 1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

### 1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

#### 1.2.6 Parts Identification

Provide identification and coverage for all parts of each component,

assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

#### 1.2.6.1 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

#### 1.2.6.2 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

#### 1.2.6.3 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

#### 1.2.6.4 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

### 1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

#### 1.3.1 Data Package 1

- a. Safety precautions
- b. Maintenance and repair procedures
- c. Warranty information
- d. Contractor information

- e. Spare parts and supply list

#### 1.3.2 Data Package 2

- a. Safety precautions
- b. Normal operations
- c. Environmental conditions
- d. Lubrication data
- e. Preventive maintenance plan and schedule
- f. Maintenance and repair procedures
- g. Removal and replacement instructions
- h. Spare parts and supply list
- i. Parts identification
- j. Warranty information
- k. Contractor information

#### 1.3.3 Data Package 3

- a. Safety precautions
- b. Normal operations
- c. Emergency operations
- d. Environmental conditions
- e. Lubrication data
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring diagrams and control diagrams
- i. Maintenance and repair procedures
- j. Removal and replacement instructions
- k. Spare parts and supply list
- l. Parts identification
- m. Warranty information
- n. Testing equipment and special tool information
- o. Contractor information

## 1.3.4 Data Package 4

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Lubrication data
- i. Preventive maintenance plan and schedule
- j. Troubleshooting guides and diagnostic techniques
- k. Wiring diagrams and control diagrams
- l. Maintenance and repair procedures
- m. Removal and replacement instructions
- n. Spare parts and supply list
- o. Corrective maintenance man-hours
- p. Parts identification
- q. Warranty information
- r. Personnel training requirements
- s. Testing equipment and special tool information
- t. Contractor information

## 1.3.5 Data Package 5

- a. Safety precautions
- b. Operator prestart
- c. Start-up, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring and control diagrams

- i. Maintenance and repair procedures
- j. Spare parts and supply list
- k. Testing equipments and special tools
- l. Warranty information
- m. Contractor information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --



## SECTION 02100

## CLEAR SITE AND REMOVE OBSTRUCTIONS

## PART 1 GENERAL

## 1.1 PROTECTION

## 1.1.1 Protection of Existing Features

Before beginning any clearing or removal of obstructions, the Contractor shall perform a topographic survey as defined in section 01200 "GENERAL REQUIREMENTS". During clearing operations, the Contractor shall take all necessary precautions to ensure against damage to existing features to remain in place or to be reused, 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.

## 1.1.2 Environmental Protection

All work and Contractor operations shall comply with the requirements of SECTION 01355A: ENVIRONMENTAL PROTECTION.

## 1.2 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

## 3.1 CLEAR SITE AND REMOVE OBSTRUCTIONS

## 3.1.1 Areas for Clearing and Removal of Obstructions

Areas to be cleared are limited to haul roads, contractor's staging areas, actual excavation areas of the project, borrow site, and areas on which fills and/or structures are to be placed. Vegetated gullies adjacent to borrow sites shall not be impacted. The removal of trees, shrubs, turf, and other vegetation outside of these areas shall be held to a minimum and care shall be exercised not to damage any trees, shrubs, turf, or vegetation which can be left in place.

### 3.1.2 Clearing

Clearing shall consist of the removal of all trees, brush, rubbish, fences, debris, or any materials within the areas for clearing and removal of obstructions. Grubbing shall be done in all areas that are stripped and consist of removing all stumps, roots, logs, and any debris exposed from the stripping operations. Roots 1-1/2 inches or more in diameter, shall be removed to a depth of 18 inches below the stripped ground surface. Stumps shall be pulled, not cut off.

### 3.1.3 Remove Obstructions

The Contractor shall remove and dispose of all existing structures and obstructions for project construction, except as otherwise noted on the drawings. This shall include removal of existing rock riprap on the spillway section.

### 3.2 DISPOSAL

All material removed, except material specified and/or indicated to be temporarily removed, salvaged, stockpiled, or indicated otherwise shall become the property of the Contractor, and shall be removed from the site and legally disposed of.

-- End of Section --

## SECTION 02130

## DIVERSION AND CONTROL OF WATER

## PART 1 GENERAL

## 1.1 REQUIREMENTS

All permanent construction shall be carried on in areas free from water. Water in varying quantities may be flowing in natural washes throughout the length of the project, as a result of rainfall or flow from upstream watersheds sources. Storm runoff from watersheds can be rapid and, during periods of rain, flash flooding may be expected. The project consists of improvements to a natural drainage course.

Within 30 days after receipt of Notice to Proceed, the Contractor shall submit a Diversion and Control of Water Plan showing the method that he proposes to use to divert water from each working area. In addition, the Contractor shall indicate:

- a) The order of work proposed to provide a continuous flood drainage system during construction.

The responsibility for damage to any part of the permanent work shall be set forth in the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. All damaged work (including temporary construction), utilities, materials, equipment, and plants shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of such damage.

## 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

## Diversion and Water Control Plan; G

Plan describing the proposed means and methods to protect each construction work areas from storm runoff.

## 1.3 DIVERSION REQUIREMENTS

The Contractor is responsible for the diversion and control of all runoff entering the construction area. The runoff will include water originating from upstream, urban runoff, adjacent drainages; and in addition any and all seepage and groundwater originating within the work. The work site may be inundated because of runoff. The Contractor shall be responsible for protection of work site during times of runoff by his own means and shall

be approved by the Contracting Officer.

The 100-year, 20-year, and 10-year peak discharges at the Robles Diversion Dam are 27,100 cfs, 19,000 cfs, and 15,000 cfs, respectively. The existing gate/spillway structure has a capacity of 6,000 cfs. The Contractor shall be prepared to handle these ranges of flow during the construction period at no additional cost to the Government.

#### 1.3.1 Downstream Diversion Activities

The Contractor shall conduct all diversion operations in such a manner as to avoid adversely impacting conditions downstream of the project. The Contractor is responsible for flows from diversion operations until they reenter the existing flow and these flows shall be returned to its pre-diversion condition. If, in the opinion of the Contracting Officer, the outflows released from the diversion activities have or are causing changes, the Contractor shall take immediate remedial measures to return the downstream channel to its pre-diversion condition. These measures will be performed by the Contractor without additional costs to the Government.

#### 1.3.2 Drainage Ditches and Sumps

The location and depth of any bypass drainage ditch or sump shall be subject to Government approval. Special precautions shall be taken to avoid impairing the permanent subgrade or embankment foundation. Any excavation below the foundation subgrade shall be refilled with compacted fill in accordance with the SECTION 02300: EARTHWORK by and at the expense of the Contractor.

#### 1.3.4 Groundwater and Dewatering

The groundwater will be encountered during construction throughout the project reach of the Robles Diversion Dam. The construction area shall be dewatered prior to commencement or continuation of the work, and all subgrades, whether for earth fill, stone, grouted stone, or concrete shall be kept drained and free of water throughout the working period. Lowering of the groundwater table can be accomplished by installing a series of dewatering wells and well pumps along the channel edges in the upper reaches and by using sumps pump in the lower reaches. The pumped water shall be directed into the temporary channels used for control of surface water. The Contractor shall submit the method of dewatering to Contracting Officer for his approval.

#### 1.3.5 Diversion and Water Control Plan

Thirty (30) calendar days prior to construction of the diversion facilities specified in paragraph: Sequence of Construction, the Contractor shall submit plans showing the proposed means and methods to dewater each working area and control the water from rain, sheet flow, streamflows, and other surface water. The plans shall show the scheme of operations and a complete layout of drainage pipes, pumps, diversion channels, cofferdams, etc. The Contractor shall assume full responsibility for the adequacy of his dewatering and control methods. **Prior notice to the Contracting Officer of the Contractor's method of dewatering will in no way release the Contractor from the fulfillment of his obligations or make the Government, in any manner, responsible for any losses due to failure or inadequacy of the dewatering and control method used.**

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.~

-- End of Section --

## SECTION 02220

## DEMOLITION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6 (1990; R 1998) Safety Requirements for  
Demolition Operations

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Change 1-2010; Change 3-2010;  
Errata 1-2010) Safety and Health  
Requirements Manual

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61-SUBPART M National Emission Standard for Asbestos

## 1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations on site. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

## 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-07 Certificates

Demolition plan; G  
Notifications; G

Proposed demolition and removal procedures for approval before  
work is started.

## SD-11 Closeout Submittals

## Receipts

Receipts or bills of lading, as specified.

### 1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ANSI A10.6.

#### 1.4.1 Notifications

##### 1.4.1.1 General Requirements

Furnish timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA) and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

### 1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

### 1.6 PROTECTION

#### 1.6.1 Existing Work

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing work in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, the location and extent of cracks and other damage and description of surface conditions that exist prior to before starting work.

#### 1.6.2 Items to Remain in Place

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

### 1.6.3 Existing Construction

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

### 1.6.4 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

### 1.6.5 Trees

Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

### 1.6.6 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor .

### 1.6.7 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

### 1.6.8 Protection of Personnel

Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.



### 1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted. Where burning is permitted, adhere to federal, state, and local regulations.

### 1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

### 1.9 REQUIRED DATA

The Demolition plan shall include procedures for coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Provide procedures for safe conduct of the work in accordance with EM 385-1-1.

### 1.10 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency requirements specified.

### 1.11 USE OF EXPLOSIVES

Use of explosives will not be permitted.

## PART 2 PRODUCTS

### 2.1 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition of structures.

## PART 3 EXECUTION

### 3.1 EXISTING FACILITIES TO BE REMOVED

#### 3.1.1 Structures

- a. Remove existing structures indicated to be removed .
- b. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed.
- c. Locate demolition equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

#### 3.1.2 Utilities and Related Equipment

##### 3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not

interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

#### 3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

#### 3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas.

#### 3.1.4 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

#### 3.1.5 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal to the greatest extent possible as part of demolition operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycle facility.

#### 3.1.6 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

- a. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

### 3.1.7 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved.

#### 3.1.7.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, must be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

#### 3.1.7.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

#### 3.1.7.3 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris and disposed of by the Contractor.

### 3.1.8 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

#### 3.1.8.1 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes,

and similar items. Box and tag these items for identification according to type and size.

#### 3.1.8.2 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

#### 3.1.8.3 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

### 3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished until all demolition in the area has been completed and debris removed. Holes, open basements and other hazardous openings shall be filled.

### 3.3 DISPOSITION OF MATERIAL

#### 3.4 CLEANUP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

### 3.5 DISPOSAL OF REMOVED MATERIALS

#### 3.5.1 Disposal

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified. Removed materials shall not be stored on the project site.

#### 3.5.2 Burning on Government Property

Burning of materials removed from demolished structures will not be permitted on Government property.

#### 3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition structures to designated spoil areas on Government property.

#### 3.5.4 Removal from Government Property

Transport waste materials removed from demolished structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

### 3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

## SECTION 02300

## EARTHWORK

## 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 within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2005) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual
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## U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. 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

Excavation Plan; G

Submit 30 days prior to starting work.

## SD-06 Test Reports

Testing Log  
Borrow Site Testing

Submit weekly.

## 1.3 DEFINITIONS

## 1.3.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, CL-ML. Satisfactory materials for grading shall be comprised of stones less than 12 inches, except for fill material for pavements which shall be comprised of stones less than 3 inches in any dimension.

## 1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials include but are not limited to construction debris, trash, refuse, and material classified as satisfactory which contains root and other organic matter. Unsatisfactory materials also include materials too wet to support construction equipment. The Contracting Officer shall be notified of any contaminated materials.

## 1.3.3 Degree of Compaction

Degree of compaction required, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density.

## PART 2 PRODUCTS

## 2.1 GENERAL

Except as designated below, the composition alone of any fill material determines where it may be used. Materials containing brush, roots, sod or other perishable materials will not be considered suitable. The suitability of the materials shall be subject to the approval of the Contracting Officer and their disposition in the levees shall be as approved by the Contracting Officer. All materials to be used as fill shall be blended during excavation.

## 2.2 REQUIREMENTS FOR OFFSITE SOILS

Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene,

Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3 Method 5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

### 2.3 IMPERVIOUS FILL

Impervious fill classifies as CL or CL-ML per ASTM D 2487. No borrow source will be designated. The soils shall be classified by a laboratory validated by the Materials Testing Center. The bid schedule should include an estimate of material that will be required.

### 2.4 TOPSOIL

Topsoil shall consist of the upper 12 inches of material stripped from the surface of the borrow area. Topsoil shall be stockpiled for later use in any areas requiring hydroseed. Excess topsoil not used for hydroseeding shall be placed in accordance with the contractor's approved excavation plan.

## PART 3 EXECUTION

### 3.1 EXCAVATION, GENERAL

#### 3.1.1 General

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Surplus satisfactory excavated material not required for fill or embankment and unsatisfactory excavated material shall be disposed of in approved disposal areas in accordance with the Contractor's approved excavation plan. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. Construction debris, trash, and refuse shall be disposed of off site. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times.

#### 3.1.2 Preservation of Property

All excavation operations shall be conducted in such a manner that concrete structures, utilities, fences, or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement. The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores, or whatever means may be necessary to adequately support material carrying such improvements or to support the improvements themselves and shall maintain such means in position until they are no longer needed. Temporary sheet piling, cribbing, bulkheads, shores, or other protective means shall remain the property of the Contractor and when no longer needed shall be removed from the site. The Contractor shall submit for approval shop drawings showing proposed method of bracing which he intends to use. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation, and shall be based upon calculation of pressures exerted by (and the condition and nature of) the materials to be retained, including surcharge imparted to



the side of the trench by equipment and stored materials. Removal of shoring shall be performed in such manner as not to disturb or damage the finished concrete or other facility.

### 3.1.3 Excavation for Structures

Excavation within the vicinity of existing structures, utilities, roads, and pipes to remain in place shall be performed in a manner to prevent damage to the structure. Earth banks and facilities to remain in place shall be supported as necessary during excavation. Potential for damage resulting from severe vibration may limit the Contractor's operations or choice of equipment. In general, unless otherwise shown or specified, the actual side slopes shall be in accordance with USACE EM 385-1-1.

### 3.1.4 Underground Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet each side of known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, the contractor shall excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. The Contractor shall report damage to utility lines or subsurface construction immediately to the Contracting Officer.

### 3.1.5 Drainage

The contractor shall provide for the collection and disposal of surface and subsurface water encountered during construction. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, the contractor shall remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and groundwater conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

### 3.1.6 Blasting

Blasting will not be permitted.

### 3.1.7 Foundation Conditions

Foundation materials along the alignment of the Robles Diversion Dam consist a zoned earthfill rockfill embankment that was constructed using the various earth materials taken from the required excavations for the diversion dam and along the Robles-Casitas Diversion Cananl, and other nearby borrow areas.

### 3.2 EXCAVATION, BORROW

#### 3.2.1 General

Borrow shall be taken from the indicated borrow areas. Material at all two borrow areas adjacent to the Robles Diversion Dam consist of finer-grained clayey and sandy soils than the allowable fill and will require substantial processing to achieve the specified gradations. The excavation shall be conducted in such a manner that the excavated area will not pond water. Permanent excavated slopes in the borrow area shall not be steeper than 5H:1V, except as approved by the Contracting Officer. The borrow area shall be left in a neat condition, graded to drain and in accordance with the requirements specified in SECTION 01355A: ENVIRONMENTAL PROTECTION.

#### 3.2.2 Excavation Plan

An excavation plan, including methods and equipment to be used in excavating each area or feature, locations of stockpiles, locations of temporary disposal areas, locations of permanent disposal areas, precautions to be taken to ensure that excavation operations do not go beyond the limits shown, haul roads into and out of excavations and location of proposed structures, shall be submitted to the Contracting Officer for approval thirty (30) calendar days prior to commencing excavation. The excavation plan shall also include the Contractor's grading plan proposal for closure of the borrow areas.

#### 3.2.3 Erosion Control

Erosion due to wind or flowing water shall be controlled during borrow operations. Areas of surface water concentration shall be drained into silt ponds to remove sediment prior to water being discharged from the borrow site into existing drainages. Reclamation shall occur concurrently with excavation to the extent possible given operational constraints of the ongoing excavation.

#### 3.2.4 Closure of Borrow Area

Upon completion of excavation from the borrow area, stockpiled topsoil from stripping operations shall be spread over the excavated surface or as directed by the Contracting Officer. The borrow area shall be revegetated according to the requirements of SECTION 02900: HYDROSEEDING.

### 3.3 REMOVAL OF UNSATISFACTORY SOILS

The removal of soils or materials which are unsatisfactory for the foundation of the levees or structures may be required in certain areas. Subgrade materials that cannot be brought to 95 percent compaction after scarification shall be removed. The Contractor will be required to excavate any such areas to the depth directed and backfill the removal areas with compacted fill conforming to the requirements of Paragraph GENERAL REQUIREMENTS FOR COMPACTED FILLS AND BACKFILLS. No excavated material or waste of any kind shall be removed beyond the project limits under this contract without the express written authority of the Contracting Officer.

### 3.4 GENERAL REQUIREMENTS FOR COMPACTED FILLS AND BACKFILLS

#### 3.4.1 Field and Laboratory Control

Testing shall be performed by an approved commercial testing laboratory. Moisture-density relations shall be established by the Contractor. The soil used for each maximum density test shall be classified in accordance with ASTM D 2487 and shall include a particle size analysis in accordance with ASTM C 136. At least one five point maximum density test shall be made for every 10 field density tests. All field density tests shall reference a specific maximum density. Testing shall be performed by the Contractor at the frequency established in paragraph Field Control, and in such locations to ensure that the specified products are being obtained. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be re-worked as necessary to meet specification requirements. Tests on re-worked areas shall be performed. Inspections and test results shall be certified by a professional civil engineer registered in the State of California. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. Test results shall be reported on forms conforming to ASTM requirements. One copy of density data less dry weight determinations shall be provided on the day each test is taken. The completed field density test and gradation reports shall be provided with the Contractor Quality Control Report on the work day following the test. All data related to the treating of compacted fill materials shall be submitted to the Contracting Officer on approved forms within 24 hours of the completion of the tests.

##### 3.4.1.1 Laboratory Control

One moisture-density relation shall be made for each classification, blend or change in classification of soil materials encountered. Approval of moisture-density relations shall be obtained prior to compacting or any material in the work. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557.

##### 3.4.1.2 Field Control

Field in-place density shall be determined in accordance with ASTM D 1556. Where the contractor believes that material size makes this impractical, he is encouraged to use the submittal process to propose alternate methods to assess the field density. The field moisture content shall be determined in accordance with ASTM D 2216 for each density test sample. The soil sample obtained from each in-place density test shall be classified in accordance with ASTM D 2487 and shall include a particle size analysis in accordance with ASTM C 136. Determination of in-place densities using the nuclear method ASTM D 2922 may be used to supplement the ASTM D 1556 sand cone density tests. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. At least one adjacent sand cone test shall be performed for every ten nuclear density tests performed. If field density tests determined by the nuclear method vary by more than 3 pounds per cubic foot from comparison sand cone tests, and are consistently high or low, adjustment of the calibration curve is necessary.

#### 3.4.1.3 Testing Log

The Contractor CQC shall maintain a log of all tests, which will be updated and submitted to the Contracting Officer on a weekly basis in both hard copy and digital formats. The test log shall include: Test number (if retest shall include retest number), date, feature of work, station and offset, elevation, moisture content, weight of dry soil, percent of compaction, optimum moisture content, maximum dry unit weight, referenced Proctor test number, soil classification, gradation (full set, uniform spacing), and in-place density test method used.

#### 3.4.1.4 Testing Frequency

Unless otherwise specified, an in-place test shall consist of one gradation, moisture content, and in-place density test. One in-place test per 2000 cubic yards shall be made of each lift of fill or backfill areas compacted by other than hand-operated machines. At least one test shall be made in each 2 foot layer of compacted fill or backfill processed as a unit, and not less than one test shall be made in each area.

#### 3.4.1.5 Testing Frequency for Hand Compacted Materials

One in-place test per 500 cubic yards, or fraction thereof, shall be made of each lift of fill or backfill areas compacted by hand-operated machines.

#### 3.4.2 Settling of Fills or Backfills with Water

Settling of fills or backfills with water will not be permitted.

### 3.5 COMPACTED FILL

#### 3.5.1 Foundation Preparation

After stripping topsoil over the entire embankment footprint and excavation of the inspection trench, and after inspection and approval by the Contracting Officer, the foundation soils shall be alternately watered and scarified until the material is uniformly moistened throughout for a depth of not less than 10 inches. The foundation material shall then be compacted to a relative density equal to or greater than the contiguous embankment fill material. No separate payment will be made for loosening and rolling the foundation, but the entire cost thereof shall be included in the applicable contract price for contiguous fill.

#### 3.5.2 Impervious Fill

a. The design assumes that the existing impervious fill/timber cutoff wall system is effective. While it is anticipated that the wall has deteriorated, there is no evidence that the structure was not built as designed; specifically, it is assumed that the impervious fill that was included in the original design is in place. The borings along the canal alignment indicate that there were ample supplies of sandy clay to clayey sand that would have functioned adequately as an impervious cutoff.

b. The Contractor's method for removal of interfering portions of the timber wall, shall not compromising the integrity of the remaining fill. This method shall be presented in a submittal for Government approval.

c. The Contracting Officer shall approve of additional impervious fill that is required, the Contractor shall provide a material which classifies as CL or CL-ML per ASTM D 2487. No borrow source will be designated. The soils shall be classified by a laboratory validated by the Materials Testing Center. The bid schedule should include a quantity estimate of material to be imported, noting that some may be salvaged from the required excavation.

### 3.5.3 Placement

#### 3.5.3.1 General

No fill shall be placed on any part of the embankment foundations until the foundation treatment has been completed and such areas have been inspected and approved by the Contracting Officer. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Fill areas that are loosened, rutted or contaminated by construction equipment shall be reworked or removed to meet specification requirements.

#### 3.5.3.2 Adjacent to Structures

Travel by heavy hauling and compacting equipment will be restricted to a distance greater than 3 feet horizontally and vertically from structures. Within restricted areas or areas where heavy compaction equipment cannot be used, the material shall be compacted by hand with power tampers or "walk behind" compaction units. Heavy equipment shall not be operated over pipes and buried structures until at least 2 feet of fill material have been placed and compacted over them. Material from the top of the pipe or buried structure to 2 feet above pipe or buried structure shall be compacted by mechanical tampers or other equipment approved by the Contracting Officer.

#### 3.5.3.3 Spreading

After dumping, the materials shall be spread as hereinafter specified for each material type, except structural backfill, which shall be spread in accordance with requirements in paragraph: STRUCTURAL BACKFILL. Roots and debris shall be removed and disposed of in an approved manner. Compacted fill shall be placed with suitable equipment in horizontal layers which before compaction, shall not exceed 8 inches in depth for rubber-tired or vibratory rollers, 6 inches in depth for tamping rollers, and 4 inches in depth when mechanical tampers are used. The Contractor may vary the layer thickness within these limits for most efficient operations. Material containing stones shall be placed in a manner to prevent the stones from striking the concrete structures and to prevent the formation of voids.

#### 3.5.4 Moisture Control

Material that is not within the specified limits after compaction shall be reworked regardless of density. The moisture content after compaction, as determined by ASTM D 2216, shall be within the limits of 2 percentage points above optimum and 2 percentage points below optimum. Optimum moisture content shall be determined in accordance with ASTM D 1557.

#### 3.5.5 Compaction

Each lift of Compacted Fill shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557.

### 3.6 STRUCTURAL BACKFILL

#### 3.6.1 Location

Backfill shall consist of all fill against and/or around structures.

#### 3.6.2 Material

Backfill material shall be obtained from the required excavation as approved by the Contracting Officer. In general, the best material available will be designated as backfill and fill about structures. Backfill may consist of sand, gravelly sand, and silty sands. Organic material, silt, clay, broken concrete of pavement, boulders, and other unsatisfactory material shall not be used. Backfill for structures shall not contain any stones larger than 3 inches.

#### 3.6.3 Placing

Backfill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 3000 psi when tested in accordance with SECTION 03301A: CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

#### 3.6.4 Compaction

Compaction shall be not less than 95 percent of maximum density per ASTM D 1557 unless noted or shown otherwise.

### 3.7 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except as otherwise specified or directed. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades re-established to the required elevations and slopes.

-- End of Section --

## SECTION 02600

## STONE PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM C 33	(2003) Concrete Aggregates
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(2004) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 295	(2003) Petrographic Examination of Aggregates for Concrete
ASTM C 535	(2003e1) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 1141	(1975; R 1980) Preparation of Substitute Ocean Water

## 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-02 Shop Drawings;

Method of Placement; G

SD-03 Product Data

Stone Sources; G

Name and location of quarry and service history of stone from the quarry as applicable to paragraph: Source Authorization Criteria.

SD-05 Design Data

Method of placement; G

SD-06 Test Reports

Stone Quality Testing  
Gradation Sampling and Testing

Quality compliance and gradation test results performed in accordance with paragraph: Stone Quality 2.1.4 and paragraph: Gradation 2.1.5.

SD-07 Certificates

Waybills and Delivery Tickets

Copies of waybills and delivery tickets shall be submitted as stated in paragraph: Waybills and Delivery Tickets.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Definitions

2.1.1.1 Rounded Stone

Stone which is obtained from alluvial deposits and is nearly spherical and well rounded.

2.1.1.2 Angular Stone

Stone which is obtained from bedrock deposits and is angular in shape.

2.1.2 General

The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing, and transporting of stone. The Contractor shall vary the quarrying, processing, loading, and placing operations, to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not fully meet all the requirements of these specifications, the Contractor shall furnish, at no additional cost to the Government, other stone meeting the requirements of these specifications.

2.1.3 Stone Sources

2.1.3.1 Stone from Project Excavation

Stone conforming to those portions of the specifications allowing the use of rounded stone may be processed and used from the required excavation(s) or borrow areas.

2.1.3.2 Salvaged Stone

Un-grouted riprap salvaged from existing facilities where specified may be used as stone for grouted riprap where it conforms to the gradation and shape requirements of this specification.



#### 2.1.3.3 Off-site Source Authorization

Before any stone is produced from an off-site source for completion of the work under this contract, the source of stone must be submitted for approval and authorized by the Contracting Officer's Representative. The Contractor shall designate in writing the off-site source from which he proposes to furnish stone. Authorization of a stone source shall not be construed as a waiver of the right of the Government to require the Contractor to furnish stone which complies with these specifications. Materials produced from localized areas, intervals, or strata will be rejected, when such materials do not comply with the specifications. Before a proposed source or sources of stone will be considered for evaluation and approval, the Contractor must demonstrate that the source is capable of providing the quality, quantities and gradation needed and at the rate needed to maintain the scheduled progress of the work.

#### 2.1.3.4 Source Authorization Criteria

Authorization of a proposed stone source will be based on test results, a quarry inspection, and/or service records. In general, current test results shall be required, as outlined in paragraph: Quality Compliance Sampling and Testing, below. In special cases, however, the Contracting Officer's Representative may elect to use either past Corps of Engineers test results, test results from other agencies or private laboratories, or service records. A service record is considered to be acceptable if stone from the proposed source has remained sound and functional after at least 10 years of exposure on a project similar to and in a similar weathering environment as the one to be constructed under these specifications.

#### 2.1.3.5 Potential Off-site Stone Sources

On the basis of information and data available to the Government, the following sources located within 75 miles from the project have in the past produced stone meeting the quality requirements of these specifications:

Quarry Name	CA Mine ID No.	Nearest City	Last Tested
Bee Rock	91-42-0006	Santa Ynez	Jan '99
El Jaro	91-42-0021	Lompoc	Jan '99
Ojai	91-56-0025	Ojai	Sep '07
Soledad Cyn	91-19-0038	Canyon Country	Mar '90

Listing of a stone source is not to be construed as to current or future availability of the source, authorization of all materials from the source, nor as a waiver of inspection and testing of the source. Stone produced from any listed source must meet all the requirements set forth in these specifications. Listing of a stone source is also not to be construed as an indication that the source can produce the total quantity or size of stone required for the project. Stone may be furnished from other sources designated by the Contractor and authorized by the Contracting Officer's Representative, subject to the conditions stated herein.

#### 2.1.4 Stone Quality

##### 2.1.4.1 Quality Compliance Sampling and Testing

If the Contractor proposes to furnish stone from a source which has not been tested by a Corps of Engineers validated laboratory in 5 years, the Contractor shall have evaluation tests performed on stone samples collected

from the proposed source. Samples of stone from a proposed source shall be taken at the quarry by the Contracting Officer's Representative, the Superintendent of the quarry, the Contractor, and an engineering geologist from the Geotechnical Branch of the Los Angeles District. The samples shall consist of at least 300 pounds of representative stone. The quarry faces and the stockpiles to be used shall be examined and sampled. The Contractor will then ship the samples at the Contractor's expense to a laboratory validated by the Army Corps of Engineers to perform the specified tests. The tests to which the stone shall be subjected and the required results are discussed below. The results of the Stone Quality Tests shall be submitted for review to the Contracting Officer's Representative a minimum of 10 days in advance of the time when the stone will be required in the work.

#### 2.1.4.2 Stone Quality Testing Requirements

Stone shall be subjected to such tests as are necessary to demonstrate to the satisfaction of the Contracting Officer's Representative that the materials are acceptable for use in the work. At a minimum, the stone shall meet the following test requirements:

Test	Test Method	Requirement
Specific Gravity (Bulk SSD)	ASTM C 127	2.55 minimum
Absorption	ASTM C 127	2.0% maximum
Wetting and Drying	SPD Test Procedure(1)	No fracturing(3)
Magnesium Sulfate Soundness	ASTM C 88(2)	10% max.loss(4)
Abrasion Loss	ASTM C 535	40% max. loss(4)

In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis, in accordance with ASTM C 295(5). The stone must not contain any expansive clays. Stone for grouted riprap shall not contain excessive amounts of deleterious minerals, associated with alkali-silica or alkali-carbonate reactions, as described in ASTM C 33.

NOTE: (1): Test procedure for wetting and drying test. The entire sample is carefully examined, and representative test specimens are selected. The sample should be large enough to produce two cut slabs, each (1 inch) with a minimum surface area of 28.8 square inches on one side. Two chunks, approximately 3 inches by 4 inches, are also chosen. The slabs and chunks are carefully examined under a low-power microscope, and all visible surface features are noted and recorded. The specimens are then oven-dried at 60 degrees C., for eight hours, cooled, and weighed to the nearest one-tenth of a gram. The test specimens are photographed, to show all surface features, before the test. The chunks and slabs are then subjected to fifteen cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in salt water, prepared in accordance with ASTM D 1141. Each cycle consists of soaking for sixteen hours, at room temperature and then drying in an oven for eight hours, at 140 degrees F. After each cycle, the specimens are examined with the low-power microscope, to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material, and any other evidence of weakness developing in the rock. The cycle in which any of these actions occurs is recorded. After fifteen cycles, the slabs and chunks are again carefully examined, and all changes in the rocks are noted and recorded. The test specimens, together with all particles broken-off during the test, are oven-dried, weighed, and photographed.

NOTE: (2): The test shall be made on 50 particles, each weighing 0.22 lbs in lieu of the gradation given in ASTM C 88.

NOTE: (3): Weakening and loss of individual surface particles is permissible, unless bonding of the surface grains softens and causes general disintegration of the surface material.

NOTE: (4): Stone which has a loss greater than the specified limit will be accepted, if the Contractor demonstrates that the stone has a satisfactory service record as defined in paragraph: Source Authorization Criteria.

NOTE: (5): The test procedure for Petrographic and X-ray Diffraction is performed according to ASTM C 295, except for the following:

- (a) A color, microscopic photograph shall be made of each stone type, and the individual minerals within the stone shall be identified by labels and arrows, upon the photograph.
- (b) A very detailed macroscopic and microscopic description shall be made of the stone, to include all the mineral constituents, individual sizes, their approximate percentages, and mineralogical histories. A description of stone hardness, texture, weathering, and durability factors shall also be discussed.
- (c) A written summary of the suitability of stone for use as stone protection, based on the Petrographic and X-ray tests and the results of ASTM C 535, shall be presented in the final laboratory report on stone quality.

#### 2.1.4.3 Stone Acceptance Criteria

Prior to placement, all stone shall be subject to acceptance, by the Contracting Officer's Representative. Acceptance of any stone shall not constitute acceptance of all stone from a source. All accepted stone shall be as follows:

- a. of the same lithology as the original stone from which test results or service records were taken as a basis for authorization of the source;
- b. sound, durable, hard, and free of laminations, weak cleavages, undesirable weathering, or blasting or handling-induced fractures which subtend more than 1/3 of the total circumference of the stone along the plane of fracturing and which would tend to increase its deterioration from natural causes;
- c. of such character that the stone will not disintegrate from the action of air, water, or the conditions of handling and placing;
- d. clean and free from earth, clay, refuse, or adherent coatings.
- e. Riprap: Riprap shall be angular quarried material, with a shape which assures interlocking with adjacent stone, and with the greatest dimension of each piece not greater than 3 times the least dimension.
- f. Stone for Grouted Riprap: Stone for grouted riprap may be either

rounded stone from required excavations or designated borrow areas, angular quarried material, or ungrouted riprap salvaged from existing facilities where specified with a shape which assures reasonable adhesion with cement grout, yet allows flow of grout throughout the layer, to ensure adequate bonding. The greatest dimension of each piece shall be not greater than 3 times the least dimension.

#### 2.1.5 Gradation

##### 2.1.5.1 General

Quality-Control gradation tests shall be conducted by the Contractor and all stone shall be within the specified gradations for a minimum of 36-inch thickness, the gradations are as shown on the the drawings. If the stone is delivered by the truckload, each truckload shall be representative of the gradation requirements. Specified grading of all material shall be met both at the source and as-delivered to the project. One gradation test for each stone size from each designated stone source is required for initial acceptance of the stone source. Subsequent gradation tests will be done on a frequency determined according to the total estimated quantity of stone. If test results show that stone does not meet the required grading, the hauling and placement operations will be stopped immediately and will not resume, until processing procedures are adjusted, and a passing gradation test is completed, showing that gradation requirements are met. All gradation tests shall be at the expense of the Contractor. All riprap gradations are as shown on the drawings.

##### 2.1.5.2 Gradation Sampling and Testing

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Tests shall be performed by an approved testing laboratory, on samples selected in the presence of the Contracting Officer's Representative. Testing may be performed by the Contractor, subject to approval by the Contracting Officer's Representative. Testing shall be supervised by a registered Civil Engineer, experienced in rock gradation testing. The Government reserves the right to perform check-tests and to use the Contractor's sampling and testing facilities to make the tests. One gradation test shall be required at the beginning of production, prior to delivery of stone from the source to the project site. A minimum of one additional test shall be required for each 3000 tons of stone placed. Each sample shall be selected at random from the production run for the first test or from stone placed on grade or stockpiled on-site for required additional tests. All sampling and gradation tests performed by the Contractor shall be in the presence of the Contracting Officer's Representative. The minimum sample sizes for each test shall be as follows:

Stone Class	Minimum sample weight
Oversized Riprap	30 tons
Riprap	9 tons
Fish Ladder Riprap	4 tons

##### 2.1.6 Rejected Stone

Stone of unsuitable quality and/or size distribution, as required by these specifications, shall be rejected. Any rejected stone shall be promptly removed from the project, at no expense to the Government. Any portions of

the work covered by these specifications containing rejected stone will be considered incomplete.

### PART 3 EXECUTION

#### 3.1 FOUNDATION PREPARATION

##### 3.1.1 General

Subgrade preparation for material placement shall conform to the provisions of SECTION 02300 EARTHWORK. Areas on which stone is to be placed shall be trimmed and dressed to conform to cross-sections, indicated or directed, within an allowable tolerance of plus or minus 1 inch from the theoretical slope-lines and grades. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with earth, similar to the adjacent material and well-compacted, or by filling with approved material, and no additional payment will be made for any material thus required. Immediately prior to placing the stone, the prepared base shall be inspected by the Contracting Officer's Representative, and no material shall be placed thereon, until that area has been approved.

#### 3.2 PLACEMENT

##### 3.2.1 General

Except as otherwise specified, the limits of stone in place shall follow, with reasonable variation, the indicated lines and slopes, without continuous under- or overbuilding. Templates shall be placed at adequate intervals, as determined by the Contracting Officer's Representative, to accurately delineate the surface of the work being placed. For all stonework, the Contractor shall submit the method of placement to the Contracting Officer's Representative for approval, before placement begins.

##### 3.2.2 Un-grouted Riprap Stone Protection

Un-grouted riprap stone protection shall be placed in a manner to produce a reasonably well-graded mass, with the minimum practicable percentage of voids, and shall be constructed to the lines and grades indicated or directed. Stone shall be placed to its full course thickness, in one operation, from the bottom of the slope or lowest portion requiring placement, to the top of the slope and in a manner to avoid displacing the underlying material. Material shall not be dropped from a height of more than 18 inches. Method of placement shall be submitted to the Contracting Officer's Representative, for approval, prior to commencement of placement operations. The Contractor shall maintain the stone protection until accepted, and any material displaced by any cause, shall be replaced, at owner's expense, to the lines and grades shown on the drawings. Self-propelled equipment shall not be used over placed stone. Hand-placing, barring, or placing by crane will be required only to the extent necessary, to secure the results specified. Placing stone by dumping into chutes or by similar methods, likely to cause segregation, will not be permitted. A tolerance of minus 2 to plus 2 inches from the indicated slope-lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet.

##### 3.2.3 Stone for Grouted Riprap

Stone for grouted riprap shall be placed in such a manner to produce a

reasonably well-graded mass and to insure that all individual stones can be satisfactorily embedded in grout. Method of placement shall be submitted to Contracting Officer's Representative, for approval, prior to commencement of placement operations. Stone shall be placed to its full course thickness, in one operation, and in such a manner to avoid displacing the underlying material. Material shall not be dropped from a height of more than 18 inches. The Contractor shall maintain the stone protection until accepted, and any material displaced by any cause shall be replaced at owner's expense, to the lines and grades indicated. Self-propelled equipment shall not be used over placed stone. Hand-placing, barring, or placing by crane will be required only to the extent necessary, to secure the results specified. Placing stone by dumping into chutes or by similar methods, likely to cause segregation will not be permitted. A tolerance of minus 2 to plus 2 inches, from the indicated slope-lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet. Use of thin, flat stones will not be permitted.

### 3.3 DEMONSTRATION SECTION

#### 3.3.1 General

Prior to placement the Contractor shall construct a section of riprap and grouted riprap, to demonstrate his proposed operations for production placement. The sections shall demonstrate procedure and capability of grading and placing stone protection within the tolerances specified. Each demonstration section shall be 50 feet wide and extend to the full height of the slope, and shall conform to all applicable specifications.

##### 3.3.1.1 Methods and Equipment

Methods and equipment employed for placement shall demonstrate the adequacy for use in placement of riprap and shall conform with the requirements specified herein. The quantities of all materials placed within the section shall be accurately tabulated and provided immediately to the Contracting Officer's Representative, for comparison with the computed quantities.

##### 3.3.2 Demonstration Section Evaluation

The Contractor shall not proceed in placing stonework, prior to the approval of the demonstration section. Within a period of 7 days after completion of the section, the Contracting Officer's Representative shall determine the adequacy of the section to function as part of the permanent construction. The Contractor shall be notified as to the acceptability of the section and may be directed to modify methods of construction, and remove the section, if necessary.

##### 3.3.3 Removal of Demonstration Section

If removal of the demonstration section is required, it shall be conducted in such a manner as to maintain the integrity of the underlying subgrade. The Contractor shall make his own arrangements for disposal in areas not located on the site.

### 3.4 DELIVERY

All stone delivered by truck shall be weighed, and the scale tickets shall

be certified, by authorized weighers. All trucks used for delivering stone shall be plainly numbered.

#### 3.4.1 Scales

Scales used for measurement shall, at the option of the Contractor, be either public scales or approved scales, provided by the Contractor. Weighing shall be at the point nearest the work at which the public scale is available or at which it is practicable for the Contractor to provide a scale. Scales shall be standard truck scales of the beam type. The scales shall be of sufficient size and capacity to accommodate all trucks used in hauling the material. Scales shall be tested, approved, and sealed by an inspector of the State Inspection Bureau, charged with scales inspection, within the state in which the project is located. Scales shall be calibrated and resealed as often as necessary, to insure continuous accuracy. The necessary number of standard weights for testing the scales shall be on hand at all times, and, if an official inspection bureau of the state is not available, the scales will be tested by the Contracting Officer's Representative.

#### 3.4.2 Waybills and Delivery Tickets

Copies of waybills or delivery tickets shall be submitted to the Contracting Officer's Representative, during the progress of the work. The Contractor shall furnish the Contracting Officer's Representative scale tickets for each load of material weighed; these tickets shall include tare weight, identification mark of each vehicle weighed, plus date, time, and location of the loading. Tickets shall be furnished at the point and time individual loads arrive at the work site. A master log of all vehicle loading shall be furnished for each day of loading operation. The Contractor shall file with the Contracting Officer's Representative the master log of loadings, certified waybills and/or certified tickets, within 24 hours of material delivery. Prior to the final payment, the Contractor shall furnish written certification that the material recorded on the submitted waybills and/or certified tickets was actually used in the construction covered by the contract.

-- End of Section --

## SECTION 02650

## GROUTING STONE PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM C 33	(2003) Concrete Aggregates
ASTM C 143	(1997) Slump of Hydraulic Cement Concrete
ASTM C 150	(2005) Portland Cement
ASTM C 172	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1998) Chemical Admixtures for Concrete

## 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-05 Design Data

## Grout Mix Design; G

Fifteen days prior to placement of grout, the contractor shall submit to the Contracting Officer the detailed mixture proportions for the specified grout.

## SD-06 Test Reports

## Aggregates; G

Thirty days prior to placement of grout, the contractor shall submit to the Contracting Officer the reports of aggregate quality tests.

## SD-07 Certificates



#### Portland Cement; G

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted in accordance with the Special Clause, CERTIFICATE OF COMPLIANCE. Cement will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports that the material meets the requirements of the specifications under which it is furnished.

#### Curing Compound; G

Certificates of compliance attesting that the curing materials meet the requirements of the specifications shall be submitted in accordance with the Special Clause, CERTIFICATE OF COMPLIANCE. Curing materials will be accepted on the basis of a manufacturer's certificate of compliance.

#### Waybills and Delivery Tickets; G.

Waybills and delivery tickets, during progress of the work.

### 1.3 PROTECTION OF COMPLETED WORK

After completion of any panel, no workman or other load shall be permitted on the grouted surface for a period of 24 hours. The grouted surface shall be protected from injurious action of the sun; shall be protected from rain, flowing water, and mechanical injury and shall be moist cured or membrane cured at the Contractor's option.

### 1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

#### 1.4.1 Aggregates

Aggregates shall be delivered to the site of the grout batching and mixing plant and stockpiled in such manner as to preclude intermingling of different materials or the inclusion of foreign materials in the stockpiles or batching operations. Sufficient aggregates shall be maintained at the site at all times to permit continuous placement and completion of any lift or section of grout started.

#### 1.4.2 Portland Cement

Cement may be supplied in bulk. When transported in a bulk form the carriers and systems for distribution of the cement will be accomplished in adequately designed weather-tight trucks, conveyors, or other means that will protect the material from exposure to moisture. All storage facilities shall permit easy access for inspection and identification. Sufficient materials shall be in storage to complete any lift or placement of grout started.

### 1.5 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the placing operation and grout production plant for checking the adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and installation of the grout and application of curing materials.

## 1.6 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all cement and grout actually used in the construction.

## PART 2 PRODUCTS

### 2.1 GROUT

#### 2.1.1 Aggregates

Aggregates shall meet the quality requirements of ASTM C 33. Aggregates shall conform to the gradation requirements of ASTM C 33 for Fine Aggregate.

#### 2.1.2 Portland Cement

Portland cement shall conform to the requirements of ASTM C 150, Type II, low alkali.

### 2.2 CURING COMPOUND

Membrane curing compound shall conform to ASTM C 309 Type 1D. Non pigmented compound shall contain a fugitive dye. The loss of water for both pigmented and non-pigmented curing compound when tested shall be not more than 0.03 pounds per square foot in 24 hours nor more than 0.09 pounds per square foot in 72 hours. In hot weather, grout cured with non-pigmented curing compound shall be shaded from the direct rays of the sun for the first 3 days of the curing period.

### 2.3 GROUT MIX DESIGN

The grout shall be composed of cement, sand, and water mixed in the proportions as directed. The estimated cement content requirement per cubic yard of grout shall be 7-1/2 sacks. The water content of the mix shall not exceed 8-1/2 gallons per sack of cement. In calculating total water content of the mix, the amount of moisture carried on the surfaces of aggregate particles shall be included.

## PART 3 EXECUTION

### 3.1 CONDITIONING OF UNDERLYING MATERIALS

Prior to grouting, the stone shall be thoroughly washed with water to wash down the fines and to prevent absorption of water from the grout. The stone shall be kept moist just ahead for the actual placing of grout. Stone shall be cleaned of soil, trash and debris prior to washing.

### 3.2 PREPARATION OF GROUT

The consistency of the grout shall be such as to permit gravity flow into the interstices of the stones with the help of spading, rodding, and brooming. Grout batches in the same course shall be uniform in mix, size, and consistency. Slump of grout mix shall be between 9 and 10 inches for the first course and between 7 and 8 inches for the second course or where one course is placed.

### 3.3 PLACING

#### 3.3.1 Mixing Time

The grout shall be mixed in a concrete mixer in the manner specified for concrete, except that time of mixing shall be as long as is required to produce a satisfactory mixture, and the grout shall be used in the work within a period of 30 minutes after mixing. Retempering of grout will not be permitted.

#### 3.3.2 Weather Limitations

##### 3.3.2.1 Hot Weather Placing

The temperature of the grout when deposited in the proper location shall not exceed 85 degrees F except as directed by the Contracting Officer.

##### 3.3.2.2 Cold Weather Placing

No grout shall be prepared except when the air temperature is at least 40 degrees F. in the shade and rising. Materials entering the mixer shall be free from ice, snow, and frozen lumps. A non-chloride based accelerating admixture, conforming to the requirements of ASTM C 494, may be used when approved in advance, by the Contracting Officer.

#### 3.3.3 Deposition of Grout

The grout shall be placed in two courses. Each course shall be placed fully, starting at the toe of the slope and working upward to top of the slope. In conditions where the stone is not placed on the slope in a continuous operation due to slope length, the grout shall be placed in two operations. The first operation shall begin at the toe and continue to approximately two feet below the placed stone section. The second operation shall continue from the end of the first to the top of the slope. Grout placing at each operation shall be a continuous process. The grout shall be brought to the place of final deposit by approved means and discharged directly on the stone by using a concrete pump. The use of a concrete shoot in placing grout will not be allowed. A splash plate of metal or wood shall be used where necessary to prevent displacement of stone directly under discharge. The flow of grout shall be directed with brooms or other approved baffles to cover the entire area and to assure that all crevices are filled. Sufficient barring shall be done to loosen tight pockets of stone and otherwise aid the penetration of grout. The first course shall fully penetrate the stone blanket. The second course shall be placed as soon as the first course has sufficiently stiffened so that it will not flow when additional grout is added. On slopes, all brooming shall be uphill.

### 3.4 FINISHING

Placement and brooming of the grouted surface shall be such that the outer layer of rock projects  $\frac{1}{3}$  to  $\frac{1}{4}$  their diameter above the grouted surface except where otherwise indicated on the drawings. Finished surfaces shall not deviate from the testing edge of a 10 foot straightedge more than  $\frac{1}{2}$  inch in any direction. After the top course has stiffened the entire surface shall be re-broomed to eliminate runs in the top course and to fill voids caused by sloughing of the layers of grout.

### 3.5 CURING AND PROTECTION

Curing of the grouted surface shall be accomplished by one of the following methods.

#### 3.5.1 Moist Curing

Moist curing shall consist of covering the grout with a uniform thickness of 6 inches of sand which shall be kept continuously saturated for a period of 14 days.

#### 3.5.2 Curing Compound

Curing compounds shall be applied as soon as the free water disappears and shall be applied in a 2-coat continuous operation by approved power-spraying equipment at a rate not to exceed 200 square feet per gallon for the combined coats. The second coat shall be applied to overlap the first coat in a direction approximately at right angle to the direction of the first application.

### 3.6 CONTRACTOR QUALITY CONTROL

#### 3.6.1 General

The individuals who sample and test grout 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.

#### 3.6.2 Inspection Details and Frequency of Testing

##### 3.6.2.1 Preparations for Placing

Stone, foundation, forms, and embedded items shall be inspected in sufficient time prior to each grout placement by the Contractor to certify to the Contracting Officer that is ready to receive grout.

##### 3.6.2.2 Slump

Slump shall be checked once during each shift that grout is produced. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143.

##### 3.6.2.3 Consolidation and Protection

The Contractor shall ensure that the grout is properly installed, finished, protected, and cured.

#### 3.6.3 Action Required

##### 3.6.3.1 Placing

The placing foreman shall not permit placing to begin until he has verified that there is an adequate number of men with appropriate bars and other such tools are available for the necessary barring and adjustment of stone as required above.

#### 3.6.3.2 Slump

Whenever a test is outside the specification limits, the results of the test shall be reported to the Contracting Officer and another test shall be immediately taken. If the results of the subsequent test indicates that the slump is not being met. The placement will cease and the contractor will readjust the mix design to achieve the proper slump. The adjusted mix will continue to meet the requirements specified above.

#### 3.6.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered to the Contracting Officer within 3 days after the end of each weekly reporting period. See Section 01451 CONTRACTOR QUALITY CONTROL.

#### 3.7 Demonstration Section

The Contractor shall provide a demonstration section of the stonework as indicated in Section: STONE PROTECTION prior to the grouted stone production. In addition, the Contractor shall provide a section of similar size and location to demonstrate his grouting stone procedures.

-- End of Section --

## SECTION 02722

## AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2005) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(2003) Sampling Aggregates
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire Cloth Sieves for Testing Purposes

## STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

CDT-217	Sand Equivalent
CDT-301	Resistance "R" Value of Treated and untreated Bases, Subbases and Basement Soils by the Stabilometer

## 1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

### 1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

### 1.2.2 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

## 1.3 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

#### Plant, Equipment, and Tools

List of proposed equipment to be used in performance of construction work, including descriptive data.

#### Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work.

### SD-06 Test Reports

#### Sampling and testing; G Density Tests; G

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 15 days before material is required for the work.

## 1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

#### 1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

#### 1.4.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

##### 1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

##### 1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

##### 1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content should be within -1 percent and +3 percent of optimum in accordance with ASTM D 1557.

##### 1.4.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556 or ASTM D 2167. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used.

##### 1.4.2.5 Wear Test

Wear tests shall be in conformance with ASTM C 131.

##### 1.4.2.6 R-Value

R-Value shall be in accordance with CDT-301.

##### 1.4.2.7 Sand Equivalent

The Sand Equivalent shall be in conformance with CDT-217.

#### 1.4.3 Testing Frequency

##### 1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index.
- c. R-Value.



d. Sand Equivalent.

e. Wear.

#### 1.4.3.2 In Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.

b. Sieve Analysis shall be performed for every 500 tons, or portion thereof, of material placed.

c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

#### 1.4.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis compaction requirements on samples taken from the completed and fully compacted ABC.

#### 1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F and rising. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements at no cost to the government.

#### 1.6 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

#### 1.7 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all aggregate materials actually used in construction.

### PART 2 PRODUCTS

#### 2.1 AGGREGATE PROPERTIES

The ABC shall consist of clean, sound, durable particles of gravel, stone, crushed stone, crushed gravel, angular sand, or other approved material.

ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate. Aggregates shall be of uniform density. Fifty percent of the material retained on the 3/8-inch screen shall have three or more freshly fractured faces. No more than five percent of the material retained on the 3/8-inch screen shall show no such faces resulting from crushing. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. Additionally, the aggregates when tested will conform to the following requirements.

Test Name	Ref Standard	Test Requirement
R-Value	CDT-301	80 min
Sand Equivalent	CDT-217	50 min
Percentage Wear	ASTM C-131	100 Revs 15 max 500 Revs 45 max
Specific Gravity	ASTM C-127	2.58 min

## 2.2 GRADATION REQUIREMENTS

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 1-1/2 inches and shall be continuously well graded within the limits specified. Sieves shall conform to ASTM E 11. Gradation of Class 2 material are shown on the design plans.

Class 2 Aggregate Grading Table

Sieve Sizes	Percent Passing
2"	100
1/2"	90-100
3/4"	50-85
No. 4	25-45
No. 30	10-25
No. 200	2-9

## 2.3 LIQUID LIMIT AND PLASTICITY INDEX

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping

with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

### 3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

### 3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

### 3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC, the underlying subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC, the underlying course shall contain no frozen material. The surface of the subgrade shall meet specified compaction and surface tolerances. The subgrade shall conform to Section 02300 EARTHWORK as applicable. Ruts or soft yielding spots in the subgrade, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless subgrades containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC. Stabilization shall be accomplished by mixing ABC into the subgrade and compacting by approved methods. The stabilized material shall be considered as part of the subgrade and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

### 3.5 INSTALLATION

#### 3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

#### 3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or be less than 3 inches when compacted. The layers shall be so

placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

### 3.5.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

### 3.5.4 Edges of Base Course

Approved fill material shall be placed along the outer edges of ABC in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

### 3.5.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus two percent of the optimum water content determined from laboratory tests as specified in paragraph: SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 95 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

### 3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated on the drawings. No individual layer shall exceed 8 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the ABC course shall be within 1/4 inch of the thickness indicated. Where the measured thickness is more than 1/4 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is

more than 1/4 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the ABC course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

#### 3.5.7 Finishing

The surface of the top layer of ABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ABC is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompactd or it shall be replaced as directed.

#### 3.5.8 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 10 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

#### 3.6 TRAFFIC

Traffic shall not be allowed on the completed ABC course.

#### 3.7 MAINTENANCE

The ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

#### 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of waste disposal areas indicated. No additional payments will be made for materials wasted or that must be replaced.

-- End of Section --

## SECTION 02900

## HYDROSEEDING

## 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.

## U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act (1995) Federal Seed Act Regulations Part 201

## ASTM INTERNATIONAL (ASTM)

ASTM D 4972 (1995a) pH of Soils

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

## Equipment

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

A listing of equipment to be used for the seeding operation.

## Delivery

Delivery schedule.

## Topsoil; G

Topsoil from the stripping and stock piling operation.

## Quantity Check; G

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

## Seed Establishment Period; G

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

## Maintenance Record; G

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of seeded plants.

## Maintenance Plan; G

Plant watering and maintenance plan indicating the Contractor's method(s) to establish a healthy stand of native plants. Provide a temporary irrigation system layout plan and or indicate method(s) of water application and maintenance required to meet specification. The watering and maintenance plan shall cover one year of plant establishment and shall include a watering and maintenance schedule.

## Application of Pesticide; G

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

## Wood cellulose fiber mulch and organic soil stabilizer; G

Application instructions recommended by the manufacturer.

## SD-04 Samples

## Delivered Topsoil; G

Samples taken from several locations at the source.

## Soil Amendments; G

A 5 pound sample.

## Mulch; G

A 5 pound sample.

## SD-06 Test Reports

## Equipment Calibration; G

Certification of calibration tests conducted on the equipment used in the seeding operation.

## Soil Test; G

Certified reports of inspections and laboratory tests, prepared

by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

#### SD-07 Certificates

Seed; G  
Topsoil; G  
pH Adjuster  
Organic Material  
Soil Conditioner  
Mulch  
Pesticide; G  
Endomycorrhizal Inoculant

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, total germination content, maximum percent weed seed content, and date tested.
- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical, mechanical and plant growth analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Mulch: Composition and source.
- h. Pesticide. EPA registration number and registered uses.
- i. Endomycorrhizal Inoculant. Composition and source.
- j. Organic soil stabilizer. Composition and source.

#### 1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

#### 1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

##### 1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

##### 1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to



the site.

#### 1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

#### 1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

#### 1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

#### 1.4.3 Storage

Materials shall be stored in designated areas. Seed shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

#### 1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

#### 1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 6 hours. Application shall commence within one hour after seed, mulch, additives and water mixture has been added to the tank.

### PART 2 PRODUCTS

#### 2.1 SEED

##### 2.1.1 Seed Classification

State-certified seed (of Southern California origin) of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.

### 2.1.2 Native Seed Species and Mixtures

Native seed species and mixtures for Borrow Site and National Housing Track Dike Construction Site shall be as follows:

<u>Common Name</u>	<u>Botanical Name</u>	<u>Pure Live Seed (PLS) lbs Per Acre</u>
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Use native seed mix as approved by the COR.

### 2.1.3 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

### 2.1.4 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as verified by the Contracting Officer.

### 2.1.5 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer. The Contractor shall make all arrangements with the seed vendor(s) to hold the required amount of seeds needed for the project. The Contractor shall verify and secure from the seed vendor(s) the required native seed species and quantity no later than 160 days or sooner prior to seeding operations.

## 2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. The topsoil shall be the top 12 inches of existing surface soil stripped and stockpiled onsite in accordance with Section 02300 EARTHWORK. Stockpiled topsoil shall be fenced and protected from contamination, trash, and debris. All weed growth shall be eradicated prior to placement. Contaminated topsoil shall be rejected and replaced with additional topsoil as specified. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test(s) for the seed specified. The Contractor shall pay for all soils tests as directed by the Contracting Officer. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 2 inches in diameter. All topsoil shall be free from viable plants and plant parts.

## 2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

### 2.3.1 pH Adjuster

The pH adjuster shall not be less than 99 percent elemental sulfur. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

### 2.3.2 Organic Material

Organic material shall consist of rotted manure and decomposed wood

derivatives.

#### 2.3.2.1 Rotted Manure

Rotted manure shall be unleached manure containing a maximum 25 percent by volume of sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

#### 2.3.2.2 Decomposed Wood Derivatives

Decomposed wood derivatives shall be rotted sawdust that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted. Rotted sawdust shall be stabilized with 7.5 pounds of nitrogen added uniformly to each cubic yard of material.

#### 2.3.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

#### 2.4 Watering Plan

The contractor shall submit for approval a watering plan prior to start of work. The plan shall include a temporary irrigation system using sprinkler heads, pvc lines, valves on timers and all incidentals, complete, including all necessary permits that the contractor is responsible to obtain. The contractor shall pay all fees and water cost. The system shall be installed per manufacturer's recommendation and meet all code regulations. If water connections are not available as verified by the contractor officer the contractor shall use temporary watering tanks or approved watering trucks.

#### 2.5 WATER

Water for native seeding and plant establishment shall be the responsibility of the Contractor, unless otherwise noted. The Contractor shall pay all water cost. Water shall not contain elements toxic to plant life.

#### 2.6 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

#### 2.7 Endomycorrhizal Inoculant

Endomycorrhizal inoculant use as a soil amendment shall consists of a 3 (three) species blend of spores of arbuscular mycorrhizal fungi as manufactured by Mycorrhizal Applications Inc. (541) 476-3985 or of equal product.

## PART 3 EXECUTION

### 3.1 INSTALLING SEED TIME AND CONDITIONS

#### 3.1.1 Seeding Time

Seed shall be installed prior to the end of the construction contract period.

#### 3.1.2 Seeding Conditions

Seeding operations shall be performed after temporary irrigation is installed and working. The contractor shall provide protection measures to ensure adverse weather conditions do not impact seed growth and will be responsible for reseeding as necessary.

#### 3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

#### 3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, mechanical and plant growth analysis. Sample collections on site shall be random over the entire site. Sample collections for stockpiled topsoil shall be at different levels in the stockpile. Six (6) samples shall be tested and the locations shall be determined by the Contracting Officer. The planting soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test of stockpiled topsoil shall determine if additional quantities of soil amendments and soil conditioners are required to meet local growing conditions for the seed species specified.

### 3.2 SITE PREPARATION

#### 3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed prior to the commencement of the seeding operation.

#### 3.2.2 Application of Soil Amendments

##### 3.2.2.1 Applying pH Adjuster

The pH adjuster shall not be less than 99 percent elemental sulfur applied at the rate of 15 lbs per 1,000 square feet. The pH adjuster shall be incorporated into the soil to a maximum 6 inch depth as part of the tillage operation.

#### 3.2.2.2 Rotted Manure

The application rate shall be 200 lbs per 1,000 square feet. The soil conditioner shall be spread uniformly over the soil and thoroughly incorporated by tillage into the soil to a maximum 6 inch depth.

#### 3.2.2.3 Applying Endomycorrhizal Inoculant

Endomycorrhizal inoculant shall be applied at the rates recommended by the manufacturer's written instructions for its intended use. Endomycorrhizal inoculant shall be incorporated into the soil to a depth of at least the top 4 inches, as applicable, and may be incorporated as part of the tillage operation. However, the inoculant shall not be incorporated into the ground more than three weeks prior to seeding operations and shall not be placed on top of the ground for more than three hours prior to incorporation into the soil.

#### 3.2.3 Tillage

Soil on slopes up to a maximum 2-horizontal-to-1-vertical shall be tilled to a minimum 6 inch depth. On slopes between 2-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other approved methods. On slopes between 2-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, soil amendments and soil conditioners shall be reduced by one-half. Rototillers shall be used where soil conditions and length of slope permit. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster and soil conditioner may be applied during this procedure.

#### 3.2.4 Prepared Surface

##### 3.2.4.1 Preparation

The prepared surface shall be a maximum 2 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

##### 3.2.4.2 Debris

Debris over a minimum 3 inch in any dimension shall be removed from the surface. Native rocks and stones may remain in the surface soil at the discretion of the Contracting Officer.

##### 3.2.4.3 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

##### 3.2.4.4 Weed Abatement

Temporary irrigation system installation, tillage operations, and finish grade shall be completed and approved prior to weed abatement operations. Contractor shall then perform a two (2) step procedure as follows:

- a. Contractor shall operate the irrigation system to keep hydroseed areas uniformly moist for a period of three (3) weeks. At the end

of the three (3) week period, Contractor shall spray all visible weeds with a contact herbicide. Application method shall be as recommended by manufacturer. After spraying, areas shall remain unwatered for a minimum of forty-eight (48) hours. Contractor shall then remove the weeds from the project.

b. Contractor shall water seven (7) additional consecutive calendar days from the first application of herbicide, and apply a contact herbicide. After the second spraying, water shall not be applied for an additional forty-eight (48) hour period. Contractor shall then remove the weeds from the project and commence hydroseeding operations.

### 3.3 INSTALLATION

Prior to installing seed, and after the preliminary weeding operations, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution or when temperature exceed 90 degree.

#### 3.3.1 Installing Seed

Seeding method shall be by Hydroseeding. Seeding procedure shall ensure even coverage.

#### 3.3.1 Broadcast Seeding

Broadcast Seeding shall be for seed re-establishment. Seed shall be uniformly broadcast at the rate indicated in paragraph 2.1.2 using broadcast seeders. Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 1-1/2 inch by raking, or other approved device. After the seed have been covered the area shall be mulch with 2 inch of decomposed wood derivatives.

#### 3.3.2 Hydroseeding

Prior to the commencement of seeding operations or change of seed mix, the seeding equipment shall be sanitized and cleaned of any pest organisms, insect and/or animal eggs, spores, weed seeds or propagules remaining from previous seeding operations.

Seed shall be mixed to ensure broadcast at the rate indicated in paragraph 2.1.2. The contractor shall follow a two step hydroseeding process:

a. Seed mixture, Gro-life used as a soil conditioner or approved equal and one-third (1/3) of the wood cellulose fiber shall be added to the appropriate amount of water, thoroughly mixed to produce a homogeneous slurry, and be applied to designated areas.

b. After the initial spraying, the Contractor shall then mix the remaining two-thirds (2/3) of the wood cellulose fiber, Ecology Control used as a organic soil stabilizer or approved equal with the appropriate amount of water, thoroughly mixed to produce a homogeneous slurry, and applied to designated areas.

The hydroseeded area shall not be rolled.

### 3.3.2 Wood cellulose fiber mulch and organic soil stabilizer

Wood cellulose fiber mulch, soil conditioner and organic soil stabilizer shall be applied as part of the hydroseeding operation. The Gro-life shall be mixed in accordance with the approved manufacturer's rate recommendations. Unless otherwise approved by the Contracting Officer, the wood cellulose fiber and organic soil stabilizer shall be applied at the following rates:

	<u>wood cellulose fiber</u>	<u>organic soil stabilizer</u>
Slopes 3:1 and flatter	1,000 lbs/acre	160 lbs/acre
Slopes between 3:1 and 1:1	1,000 lbs/acre	170 lbs/acre
Slopes 1:1 and steeper	1,000 lbs/acre	180 lbs/acre

### 3.3.3 Watering Seed

The temporary irrigation system shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1-1/2 inch depth. Run-off and puddling shall be prevented. Watering trucks (where water connections are not available) shall not be driven over seeded areas, unless otherwise approved by the Contracting Officer. Truck route shall be as shown on the maintenance plan. Watering of other adjacent areas or plant material shall be prevented.

### 3.4 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

### 3.5 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted to the Contracting Officer

#### 3.5.1 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. Water for formulating shall only come from filling hoses fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

### 3.6 RESTORATION AND CLEAN UP

#### 3.6.1 Restoration

Seeded areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's

expense.

### 3.6.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite on a daily basis. Adjacent paved areas shall be cleaned

### 3.7 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with this specifications.

### 3.8 SEED ESTABLISHMENT PERIOD

#### 3.8.1 Commencement

The plant establishment period to obtain a healthy stand of plants shall begin after seeding operation have been completed and approved by the Contracting Officer. The seed establishment period shall be 6 months from the date of Contracting Officer's approval. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

#### 3.8.2 Proper Stand of Hydroseed

The seeded area shall have a solid soil surface growth ground covering with bare spots no larger than 4 inches square and with bare areas not to exceed 2 percent of the total seeded area.

#### 3.8.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting seeded areas from surface erosion; maintaining slopes to design conditions; protecting installed areas from traffic; trash removal; watering; and post-fertilization. Weeds shall be removed as soon as possible and as directed by the Contracting Officer. The Contractor shall provide sufficient work force to remove all weeds from all seeded areas within a 2-week period.

##### 3.8.3.1 Maintenance Plan

The Contractor shall submit a plan, subject to approval by the Contracting Officer, for watering and maintenance requirements to establish a healthy stand of native plants. The plan shall include watering layouts, procedures and schedules, including but not limited to the temporary irrigation system plan with irrigation lines, valves and equipment layout, maintenance procedures and labor. Other method(s) of water application shall be submitted to the Contracting Officer for approval. Watering trucks shall not be driven over seeded areas, unless an approved route is establish with the least amount of disturbance to the planted areas. The Contractor shall not vary from the plan route once approved by the Contracting Officer. After the plant establish period is over the Contractor shall seed the area disturbed by the watering truck in accordance with paragraph BROADCAST SEEDING.



### 3.8.3.2 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph: APPLICATION OF PESTICIDE.

### 3.8.3.3 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph: SITE PREPARATION.

### 3.8.3.4 Maintenance Record

A written record shall be furnished to the Contracting Officer describing the maintenance work performed; day and amount of water applied, areas weeded, areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

## 3.9 FINAL ACCEPTANCE

### 3.9.1 Preliminary Inspection

Prior to the completion of the establish period, a preliminary inspection shall be held by the Contracting Officer. Time for the inspection shall be establish in writing. The acceptability of the seeded areas in accordance with the specification shall be determined. An unacceptable stand of hydroseeded area shall be replanted in accordance with paragraph BROADCAST SEEDING and as directed by the Contracting Officer as soon as seeding conditions permit.

### 3.9.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determined that the deficiencies noted in the preliminary inspection have been corrected. Time for the final inspection shall be in writing.

-- End of Section --

## SECTION 03100A

## STRUCTURAL CONCRETE FORMWORK

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ACI INTERNATIONAL (ACI)

ACI 347R (2003) Guide to Formwork for Concrete

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

## U.S. DEPARTMENT OF COMMERCE (DOC)

PS1 (1995) Construction and Industrial Plywood  
(APA V995)

## 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-02 Shop Drawings

## Formwork; G

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

## SD-03 Product Data

## Design

Design analysis and calculations for form design and methodology used in the design.

## Form Materials

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

## Form Releasing Agents

Manufacturer's recommendation on method and rate of application

of form releasing agents.

### 1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03301A CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

## PART 2 PRODUCTS

### 2.1 FORM MATERIALS

#### 2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to PS1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

#### 2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to PS1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

#### 2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

#### 2.1.4 Pan-Form Units

Pan-form units for one-way or two-way concrete joist and slab construction shall be factory-fabricated units of the approximate section indicated. Units shall consist of steel or molded fiberglass concrete form pans. Closure units shall be furnished as required.

#### 2.1.5 Form Ties

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface. Removable tie rods shall not be allowed. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete. After forms are removed, cone shape voids left by form ties at least 1 inch in diameter and 1 1/2 inches deep to allow for proper patching.

### 2.1.6 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03301A CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

#### 3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

#### 3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

#### 3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be

demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 10 feet of length ----- 1/4 inch
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length ----- 1 inch
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 20 feet of length ----- 1/4 inch Maximum for entire length----- 1/2 inch
2. Variation from the level or from the grades indicated on the drawings:	In any 10 feet of length -----1/4 inch In any bay or in any 20 feet of length----- 3/8 inch
a. In slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length ----- 3/4 inch
b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length ----- 1/4 inch Maximum for entire length----- 1/2 inch
3. Variation of the linear building lines from established position in plan	In any 20 feet ----- 1/2 inch Maximum -----1 inch
4. Variation of distance between walls, columns, partitions	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total variation
5. Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ----- 1/4 inch Plus ----- 1/2 inch

TABLE 1

TOLERANCES FOR FORMED SURFACES

6.	Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus -----	1/4 inch
		Plus -----	1/2 inch
7.	Footings:		
a.	Variation of dimensions in plan	Minus -----	1/2 inch
		Plus -----	2 inches
			when formed or plus 3 inches
			when placed against unformed excavation
b.	Misplacement of eccentricity		2 percent of the footing width in the direction of misplacement but not more than 2 inches
c.	Reduction in thickness of specified thickness	Minus -----	5 percent
8.	Variation in steps:	Riser -----	1/8 inch
a.	In a flight of stairs	Tread -----	1/4 inch
b.	In consecutive steps	Riser -----	1/16 inch
		Tread -----	1/8 inch
	-- End of Section --		

## SECTION 03151A

## EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS IN CONCRETE FOR CIVIL WORKS

## 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 within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM C 920	(2005) Elastomeric Joint Sealants
ASTM D 1751	(2004) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2628	(1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 2003) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

## U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Specifications for Polyvinylchloride Waterstops

## 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-03 Product Data

## Splicing Waterstops; G

Procedures for splicing waterstops shall be submitted for approval.

## SD-04 Samples

### Field Molded Sealants and Primer

One gallon of field-molded sealant and one quart of primer (when primer is recommended by the sealant manufacturer) shall be provided for testing.

### Waterstops; G

Waterstop materials and splice samples shall be submitted for inspection and testing and shall be identified to indicate manufacturer, type of material, size and quantity of material and shipment represented. Each materials sample shall be a piece not less than 12 inches long cut from each 200 feet of finished waterstop furnished, but not less than a total of 4 linear feet of each type and size furnished. For spliced segments of waterstops to be installed in the work, one spliced sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site shall be furnished for inspection and testing. The spliced samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each spliced sample shall be not less than 12 inches long.

### SD-06 Test Reports

Premolded Expansion Joint Filler Strips  
Compression Seals and Lubricant  
Metallic Waterstops

Certified manufacturer's test reports shall be provided for premolded expansion joint filler strips, compression seals and lubricant, and metallic waterstops to verify compliance with applicable specification.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Premolded Expansion Joint Filler Strips

Premolded expansion joint filler strips shall conform to ASTM D 1751 or ASTM D 1752, Type I, or resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

#### 2.1.2 Joint Seals and Sealants

##### 2.1.2.1 Field Molded Sealants and Primer

Field molded sealants and primer shall conform to ASTM C 920, Type M, Grade NS or P, Class 25, Use NT for horizontal joints and Type M, Grade NS, Class 25, Use NT for vertical joints. Except, the joint sealant will perform for the same life cycle when continuously underwater. The manufacturer shall certify and submit test results supporting durability under this environment. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, nonshrink, nonreactive with sealant, and nonabsorptive material type such as extruded butyl or polychloroprene foam rubber.



#### 2.1.2.2 Compression Seals and Lubricant

Compression seals shall conform to ASTM D 2628; lubricant for installation shall conform to ASTM D 2835.

#### 2.1.3 Waterstops

##### 2.1.3.1 Non-Metallic Waterstops

Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572.

### 2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

#### 2.2.1 Materials Tests

##### 2.2.1.1 Field-Molded Sealants

Samples of sealant and primer, when use of primer is recommended by the manufacturer, as required in paragraph FIELD MOLDED SEALANTS AND PRIMER, shall be tested by and at the expense of the Government for compliance with paragraph FIELD MOLDED SEALANTS AND PRIMER. If the sample fails to meet specification requirements, new samples shall be provided and the cost of retesting will be deducted from payments due the Contractor.

##### 2.2.1.2 Non-Metallic Waterstops

Samples of materials and splices as required in paragraph WATERSTOPS shall be visually inspected and tested by and at the expense of the Government for compliance with COE CRD-C 513 or COE CRD-C 572 as applicable. If a sample fails to meet the specification requirements, new samples shall be provided and the cost of retesting will be deducted from payments due the Contractor.

#### 2.2.2 Splicing Waterstops

##### 2.2.2.1 Procedure and Performance Qualifications

Procedure and performance qualifications for splicing waterstops shall be demonstrated in the presence of the Contracting Officer.

##### 2.2.2.2 Non-Metallic Waterstops

Procedure and performance qualifications for splicing non-metallic waterstops shall be demonstrated by the manufacturer at the factory and the Contractor at the job site by each making three spliced samples of each size and type of finished waterstop.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Joint locations and details, including materials and methods of installation of joint fillers and waterstops, shall be as specified, as shown, and as directed. In no case shall any fixed metal be continuous through an expansion or contraction joint.

### 3.1.1 Expansion Joints

Premolded filler strips shall have oiled wood strips secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces. The wood strips shall be slightly tapered, dressed and of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant or seals to the size shown. Material used to secure premolded fillers and wood strips to concrete shall not harm the concrete and shall be compatible with the joint sealant or seals. The wood strips shall not be removed until after the concrete curing period. The groove shall be thoroughly cleaned of all laitance, curing compound, foreign materials, protrusions of hardened concrete and any dust which shall be blown out of the groove with oil-free compressed air.

#### 3.1.1.1 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degrees F. Immediately prior to installation of field molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents or other means as recommended by the sealant manufacturer. The joints shall be dry prior to filling with sealant. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

#### 3.1.1.2 Joints With Preformed Compression Seals

The joint seals shall be installed with equipment which shall be capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal and with no more than five percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant, and the seal shall be installed to the depth indicated with joint installation equipment. Butt joints shall be coated with liberal applications of lubricant.

### 3.1.2 Contraction Joints

Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Waterstops shall be protected during application of bond breaking material to prevent them from being coated.

#### 3.1.3 Waterstops

Waterstops shall be carefully and correctly positioned during installation to eliminate faulty installation that may result in joint leakage. The bottom of each waterstop shall be embedded a minimum of 6 inches in firm rock or sealed to other cut-off systems. All waterstops shall be installed so as to form a continuous watertight diaphragm in each joint. Adequate provision shall be made to support and protect the waterstops during the progress of work. Any waterstop punctured or damaged shall be replaced or repaired at the Contractor's expense. The concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

### 3.1.3.1 Splices

Joints in waterstops shall be spliced together by qualified splicers using the approved splicing procedures to form a continuous watertight diaphragm. Splices shall be as followed:

a. Polyvinylchloride Waterstops - Splices shall be made by heat sealing the adjacent surfaces in accordance with the approved procedure. A thermostatically controlled electrical heat source shall be used to make all splices. The correct temperature at which splices should be made will differ with the material concerned but the applied heat should be sufficient to melt but not char the plastic. Waterstops shall be reformed at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled and bent by hand in as sharp an angle as possible, shall show no sign of separation.

-- End of Section --

## SECTION 03200A

## CONCRETE REINFORCEMENT

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ACI INTERNATIONAL (ACI)

ACI 318/318R (2005) Building Code Requirements for  
Structural Concrete and Commentary

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1998) Structural Welding Code -  
Reinforcing Steel

## ASTM INTERNATIONAL (ASTM)

ASTM A 184/A 184M (2001) Fabricated Deformed Steel Bar Mats  
for Concrete Reinforcement

ASTM A 497/A 497M (2002) Steel Welded Wire Reinforcement,  
Deformed, for Concrete

ASTM A 615/A 615M (2005a) Deformed and Plain Billet-Steel  
Bars for Concrete Reinforcement

ASTM A 706/A 706M (2004b) Low-Alloy Steel Deformed and Plain  
Bars for Concrete Reinforcement

ASTM A 767/A 767M (2000b) Zinc-Coated (Galvanized) Steel  
Bars for Concrete Reinforcement

ASTM A 775/A 775M (2001) Epoxy-Coated Reinforcing Steel Bars

ASTM A 82 (2002) Steel Wire, Plain, for Concrete  
Reinforcement

ASTM A1035/A1035M (2011) Standard Specification for Deformed  
and Plain, Low-carbon, Chromium, Steel  
Bars for Concrete Reinforcement

ASTM A 884/A 884M (2004) Epoxy-Coated Steel Wire and Welded  
Wire Reinforcement

ASTM C 1116 (2003) Fiber-Reinforced Concrete and  
Shotcrete

## CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 1MSP

(2001) Manual of Standard Practice

## 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-02 Shop Drawings

Reinforcement; G, AE

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

## SD-03 Product Data

Welding

A list of qualified welders names.

## SD-07 Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

## 1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

## 1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

## PART 2 PRODUCTS

## 2.1 DOWELS

Dowels shall conform to ASTM A1035/A1035M.

## 2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

### 2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

### 2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 497/A 497M. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

### 2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

### 2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 1MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

### 2.7 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inches.

## PART 3 EXECUTION

### 3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

#### 3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as

indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

### 3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

### 3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

### 3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

### 3.4 SYNTHETIC FIBER REINFORCED CONCRETE

Fibrillated polypropylene micro-fibers reinforcement shall be added to the concrete mix in accordance with the applicable sections of ASTM C 1116 and the recommendations of the manufacturer, and in an amount of 0.1 percent by volume.

-- End of Section --

## SECTION 03301A

## CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS

## 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 within the text by the basic designation only.

## ACI INTERNATIONAL (ACI)

- |              |   |
|--------------|---|
| ACI 117/117R | (1990; R 2002) Standard Tolerances for Concrete Construction and Materials      |
| ACI 211.1    | (1991; R 2002) Selecting Proportions for Normal, Heavyweight, and Mass Concrete |
| ACI 214R     | (2002) Evaluation of Strength Test Results of Concrete                          |
| ACI 305R     | (1999) Hot Weather Concreting   |

## AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- |              |   |
|--------------|---|
| AASHTO M 182 | (2005) Burlap Cloth Made from Jute or Kenaf |
|--------------|---|

## ASTM INTERNATIONAL (ASTM)

- |                     |  |
|---------------------|--|
| ASTM C 1017/C 1017M | (2003) Chemical Admixtures for Use in Producing Flowing Concrete   |
| ASTM C 1059         | (1999) Latex Agents for Bonding Fresh to Hardened Concrete   |
| ASTM C 1064/C 1064M | (2005) Temperature of Freshly Mixed Hydraulic-Cement Concrete  |
| ASTM C 1077         | (2005; Rev A) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation |
| ASTM C 1107         | (2005) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)  |
| ASTM C 1240         | (2005) Silica Fume Used in Cementitious Mixtures   |
| ASTM C 127          | (2004) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate  |



ASTM C 128	(2004a) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 136	(2005) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2005) Slump of Hydraulic Cement Concrete
ASTM C 150	(2005) Portland Cement
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(2004) Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2005) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2004) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Concrete Aggregates
ASTM C 39/C 39M	(2004a) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	(2004) Organic Impurities in Fine Aggregates for Concrete
ASTM C 494/C 494M	(2005) Chemical Admixtures for Concrete
ASTM C 566	(1997; R 2004) Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 595	(2005) Blended Hydraulic Cements
ASTM C 618	(2005) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 87	(2005) Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C 881/C 881M	(2002) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 94/C 94M	(2004a) Ready-Mixed Concrete
ASTM D 75	(2003) Sampling Aggregates

## NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100

(2000) Concrete Plant Standards

## U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104

(1980) Method of Calculation of the  
Fineness Modulus of Aggregate

COE CRD-C 400

(1963) Requirements for Water for Use in  
Mixing or Curing Concrete

COE CRD-C 521

(1981) Standard Test Method for Frequency  
and Amplitude of Vibrators for Concrete

COE CRD-C 94

(1966) Specification for Surface Retarders

## 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-03 Product Data

## Concrete Mixture Proportioning; G

Concrete mixture proportions shall be determined by the Contractor and submitted for review. 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 and ground granulated blast-furnace (GGBF) 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.

## Batch Plant; G

The Contractor shall submit batch plant data to the Contracting Officer for review for conformance with applicable specifications.

Concrete Mixers  
Capacity

The Contractor shall submit concrete mixer data which includes the make, type, and capacity of concrete mixers proposed for mixing concrete.

## Conveying Equipment

Data on the conveying equipment and methods for transporting,

handling, and depositing the concrete.

#### Placing Equipment

Data on placing equipment and methods.

#### Tests and Inspections

##### Testing Technicians

Concrete Transportation Construction Inspector (CTCI)

Concrete Construction Inspector (CCI)

Statements that the concrete testing technicians and the concrete inspectors meet the specified requirements.

#### Construction Joint Treatment; G

The method and equipment proposed for joint cleanup and waste disposal shall be submitted for review and approval.

#### Curing and Protection; G

The curing medium and methods to be used shall be submitted for review and approval.

#### Cold-Weather Placing; G

If concrete is to be placed under cold-weather conditions, the proposed materials, methods, and protection shall be submitted for approval.

#### Hot-Weather Placing; G

##### Finishing; G

If concrete is to be placed under hot-weather conditions, the proposed materials and methods shall be submitted for review and approval.

#### SD-04 Samples

##### Aggregates; G

Cementitious Materials, Admixtures, and Curing Compound; G

Samples of materials for government testing and approval.

#### SD-06 Test Reports

##### Quality of Aggregates; G

Aggregate quality tests shall be submitted at least 30 days prior to start of concrete placement.

##### Mixer Uniformity.

The results of the initial mixer uniformity tests shall be submitted at least 5 days prior to the initiation of placing.

#### Tests and Inspections

Test results and inspection reports shall be submitted daily and

weekly.

#### SD-07 Certificates

##### Cementitious Materials; G

Cementitious Materials, including Cement and Pozzolan, and Ground Granulated Blast-Furnace Slag will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished. Certification and mill test reports shall be from samples taken from the particular lot furnished. No cementitious materials shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious materials 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. Material not meeting specifications shall be promptly removed from the site of work.

##### Impervious-Sheet Curing Materials

Impervious-Sheet Curing Materials shall be certified for compliance with all specification requirements.

##### Air-Entraining Admixture

Air-Entraining Admixture shall be certified for compliance with all specification requirements.

##### Other Chemical Admixtures

Other Chemical Admixtures shall be certified for compliance with all specification requirements.

##### Membrane-Forming Curing Compound

Membrane-Forming Curing Compound shall be certified for compliance with all specification requirements.

##### Epoxy Resin

##### Latex Bonding Compound

Epoxy Resin and Latex Bonding Compound shall be certified for compliance with all specification requirements.

### 1.3 GOVERNMENT TESTING AND SAMPLING

The Government will sample and test aggregates and concrete 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 ASTM D 75. Concrete will be sampled in accordance with ASTM C 172.

## 1.3.1 Not Used

## 1.4 DESIGN REQUIREMENTS

## 1.4.1 Concrete Strength

Specified compressive strength  $f'_c$  shall be as follows:

COMPRESSIVE STRENGTH (PSI)	STRUCTURE OR PORTION OF STRUCTURE
5,000 @ 28 days	foundations, aprons, slabs, walls
4,000 @ 28 days	all other concrete

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

Maximum W/C shall be as follows:

WATER-CEMENT RATIO, BY MASS	STRUCTURE OR PORTION OF STRUCTURE
0.40	foundations, aprons, slabs, walls
0.45	all other concrete

These W/C's may cause higher strengths than that required by paragraph CONCRETE STRENGTH. The maximum W/C required will be the equivalent W/C as determined by conversion from the weight ratio of water to cement plus pozzolan, by the weight equivalency method as described in ACI 211.1.

## 1.5 CONSTRUCTION TOLERANCES

Except as specified otherwise, a plus tolerance increases and a minus tolerance decreases the dimension to which it applies. A tolerance without sign means plus or minus. Where only one sign is specified, there is no limit in the other direction. Tolerances are not cumulative. The most restrictive tolerance will control. Tolerances shall not extend the structure beyond legal boundaries.

- a. 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.
- b. Construction tolerances shall meet the requirements of ACI 117/117R and any of the following requirements that are applicable.

## 1.5.1 Formed Concrete Surfaces

For High Velocity flow, Class A-HV-Abrupt variation, a positive offset between concrete surfaces is a raise of elevation in the direction of water flow and a negative offset is a drop of elevation in the direction of the water flow.

Direction of water flow	+ 0 inches - 1/8 inch
Perpendicular to the direction of water flow	1/8 inch

## PART 2 PRODUCTS

## 2.1 MATERIALS

## 2.1.1 Cementitious Materials

Cementitious materials shall be portland cement, portland-pozzolan cement, portland blast-furnace slag cement, portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in architectural concrete shall be restricted to one color, one source, and one type.

## 2.1.1.1 Portland Cement

ASTM C 150, Type I or II, except that the maximum amount of C3A in Type I cement shall be 15 percent including the heat of hydration at 7 days including false set requirements low alkali when used with aggregates listed at the end of this section which require it. In lieu of low-alkali cement, the Contractor may use a combination of portland cement that does not meet the low-alkali requirement with a pozzolan or GGBF slag provided the following requirement is met. The expansion of the proposed combination when tested in accordance with ASTM C 441 shall be equal to or less than the expansion of a low-alkali cement meeting the requirements of ASTM C 150 when tested in general conformance with ASTM C 441. The expansion tests shall be run concurrently at an independent laboratory that is nationally recognized to perform such tests. The Government reserves the right to confirm the test results and to adjust the percentage of pozzolan or slag in the combination to suit other requirements.

## 2.1.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III, with C3A limited to 5 percent.

## 2.1.1.3 Pozzolan, Other than Silica Fume

Pozzolan shall conform to ASTM C 618, Class C or F, with the optional requirements for multiple factor, drying shrinkage, and uniformity of Table 2A.

## 2.1.1.4 Silica Fume

Silica fume may be furnished as a dry, densified material or as a slurry. Silica fume, unprocessed, or before processing into a slurry or a densified material, shall conform to ASTM C 1240 with the Specific Surface Area and Uniformity Requirements in Table 4 invoked.

The Contractor shall provide at his expense the services of a manufacturer's technical representative, experienced in mixture proportioning, placement procedures, and curing of concrete containing silica fume. The manufacturer's representative shall be available for consultation by both the Contractor and the Government during mixture proportioning, planning, and production of silica-fume concrete and shall be onsite immediately prior to and during at least the first placement of concrete containing silica fume, and at other times if directed.

## 2.1.1.5 Blended Hydraulic Cement

Portland-pozzolan cement shall conform to ASTM C 595, Type IP.

## 2.1.2 Aggregates

### 2.1.2.1 General

Concrete aggregates may be furnished from any source capable of meeting the quality requirements as stated in paragraph QUALITY. A list of sources capable of meeting the quality requirements when suitably processed can be provided by the contracting officer. No guarantee is given or implied that any of the listed sources are currently capable of producing aggregates that meet the required quality stated in paragraph QUALITY. A Design Memorandum containing the results of the government investigation and test results is available for review in the Los Angeles district office. Contact Juan Martinez at (213) 452-3649 to arrange for review of the memorandum. The 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. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33. The nominal maximum size shall be as listed in paragraph NOMINAL MAXIMUM-SIZE COARSE AGGREGATE. Where the use of highway department gradations are permitted, proposed gradations shall be submitted for approval.

### 2.1.2.2 Concrete Aggregate Sources

a. 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. If the Contractor proposes to furnish aggregates from a source or from sources not listed at the end of this section, he may designate only a single source or single combination of sources for aggregates. Regardless of the source, selected samples for acceptance testing shall be provided as required by paragraph GOVERNMENT TESTING AND SAMPLING. If a source for coarse or fine aggregates so designated by the Contractor does not meet the quality requirements stated in paragraph QUALITY, the Contractor may not submit for approval other non-listed sources but shall furnish the coarse or fine aggregate, as the case may be, from sources listed at the end of this section at no additional cost to the Government.

### 2.1.2.3 Quality

Fine and coarse aggregates delivered to the mixer shall be tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C 1260. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, the aggregate(s) shall be rejected or additional testing using ASTM C 1260 and ASTM C 1567 shall be performed. The additional testing using ASTM C 1260 and ASTM C 1567 shall be performed using the low alkali portland cement in combination with Class F fly ash. Class F fly ash shall be used in the range of 25 to 40 percent of the total cementitious material by mass.

### 2.1.3 Chemical Admixtures

Chemical admixtures to be used, when required or permitted, shall conform to the appropriate specification listed.

#### 2.1.3.1 Air-Entraining Admixture

The air-entraining admixture shall conform to ASTM C 260 and shall consistently cause the concrete to have an air content in the specified ranges under field conditions.

#### 2.1.3.2 Accelerating Admixture

Accelerators shall meet the requirements of ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

#### 2.1.3.3 Water-Reducing or Retarding Admixture

a. Water-Reducing or Retarding Admixtures: ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

b. High-Range Water Reducing Admixture: ASTM C 494/C 494M, Type F or G except that the 6-month and 1-year strength requirements shall be waived. The admixture may be used only when approved by the Contracting Officer, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan.

#### 2.1.3.4 Other Chemical Admixtures

Other chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type 1 or 2. These admixture shall be used only for concrete listed in paragraph SLUMP.

#### 2.1.4 Curing Materials

##### 2.1.4.1 Impervious-Sheet Curing Materials

Impervious-sheet curing materials for all slabs greater than 12" thick shall conform to ASTM C 171, type optional, except polyethylene film shall not be used.

##### 2.1.4.2 Membrane-Forming Curing Compound

The membrane-forming curing compound for all other members not slabs greater than 12" thick shall conform to ASTM C 309, Type 1-D or 2, except a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, coating, or flooring specified. Nonpigmented compound shall contain a fugitive dye and shall have the reflective requirements in ASTM C 309 waived.

##### 2.1.4.3 Burlap

Burlap used for curing shall conform to AASHTO M 182.

#### 2.1.5 Water

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that nonpotable



water may be used if it meets the requirements of COE CRD-C 400.

#### 2.1.6 Nonshrink Grout

Nonshrink grout shall conform to ASTM C 1107 and shall be a commercial formulation suitable for the application proposed.

#### 2.1.7 Latex Bonding Compound

Latex bonding compound agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

#### 2.1.8 Epoxy Resin

Epoxy resin for use in repairs shall conform to ASTM C 881/C 881M, Type III, Grade I or II.

### 2.2 CONCRETE MIXTURE PROPORTIONING

#### 2.2.1 Quality of Mixture

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 Nominal Maximum-Size Coarse Aggregate

Nominal maximum-size coarse aggregate shall be 1 inch except 3/4 inch nominal maximum-size coarse aggregate shall be used when any of the following conditions exist: the narrowest dimension between sides of forms is less than 7-1/2 inches, the depth of the slab is less than 4 inches, or the minimum clear spacing between reinforcing is less than 2-1/4 inches.

#### 2.2.3 Air Content

Air content as delivered to the forms and as determined by ASTM C 231 shall be between 4 and 7 percent except that when the nominal maximum-size coarse aggregate is 3/4 inch, it shall be between 4.5 and 7.5 percent.

#### 2.2.4 Slump

The slump shall be determined in accordance with ASTM C 143/C 143M and shall be within the range of 1 to 4 inches. Where placement by pump is approved, the slump shall not exceed 6 inches. Concrete to be placed in walls may contain a chemical admixture for use in producing flowing concrete in accordance with ASTM C 1017/C 1017M, and the slump of the concrete shall not exceed 8 inches.

#### 2.2.5 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 silica fume by mass equivalency as described in ACI 211.1. 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/C 192M. They shall be tested at 7 days and at the design age specified in paragraph DESIGN REQUIREMENTS in accordance with ASTM C 39/C 39M. From these test results, a curve will be plotted showing the relationship between water-cement ratio and strength.

#### 2.2.6 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.

##### 2.2.6.1 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 214R. 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:

$$\begin{aligned} f'_{cr} &= f'_c + 1.34S \\ f'_{cr} &= f'_c + 2.33S - 500 \end{aligned}$$

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	
	Use tabulation in paragraph DETERMINING REQUIRED AVERAGE STRENGTH	
less than 15		
15		1.16
20		1.08
25		1.03

NUMBER OF TESTS*	MODIFICATION FACTOR FOR STANDARD DEVIATION Use tabulation in paragraph DETERMINING REQUIRED AVERAGE STRENGTH
less than 15	
30 or more	1.00

\*Interpolate for intermediate numbers of tests.

#### 2.2.6.2 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  $f'_{cr}$  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,

$$f'_{cr} = f'_c + 1,400.$$

### PART 3 EXECUTION

#### 3.1 EQUIPMENT

##### 3.1.1 Capacity

The batching, mixing, conveying, and placing equipment shall have a capacity of at least 200 cubic yards per hour.

##### 3.1.2 Batch Plant

Batch plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

##### 3.1.2.1 Batching Tolerances

###### a. Weighing Tolerances

MATERIAL	PERCENT OF REQUIRED MASS
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

b. Volumetric Tolerances - For volumetric batching equipment, the following tolerances shall apply to the required volume of material being batched:

Water: ..... Plus or minus 1 percent.

Chemical admixtures: ..... Zero to plus 6 percent.

#### 3.1.2.2 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the masses of the materials being batched.

#### 3.1.3 Concrete Mixers

The concrete mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

##### 3.1.3.1 Stationary Mixers

Concrete plant mixers shall be tilting, nontilting, horizontal-shaft, vertical-shaft, or pugmill and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

##### 3.1.3.2 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

#### 3.1.4 Conveying Equipment

The conveying equipment shall conform to the following requirements.

##### 3.1.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

##### 3.1.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically

operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

#### 3.1.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment may be used for transporting plant-mixed concrete over a smooth road when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

#### 3.1.4.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

#### 3.1.4.5 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

#### 3.1.5 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 to 2-1/2	9,000 to 13,500	0.02 to 0.04
General construction	2 to 3-1/2	8,000 to 12,000	0.025 to 0.05

The frequency and amplitude shall be determined in accordance with COE CRD-C 521.

### 3.2 PREPARATION FOR PLACING

#### 3.2.1 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding, including tack welding, will not be

permitted on embedded metals within 2 feet of the surface of the concrete.

### 3.2.2 Concrete on Earth Foundations

Earth surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the earth foundation shall have been satisfactorily compacted in accordance with Section 02300 EARTHWORK.

### 3.2.3 Concrete on Rock Foundations

Rock surfaces upon which concrete is to be placed shall be clean, free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached, or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, all rock surfaces shall be cleaned thoroughly by the use of air-water jets 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 layer of mortar proportioned similar to that in the concrete mixture. The mortar shall be covered with concrete before the time of initial setting of the mortar.

### 3.2.4 Construction Joint Treatment

Construction joint treatment shall conform to the following requirements.

#### 3.2.4.1 Joint Preparation

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Air-water cutting will not be permitted on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean, well bonded coarse aggregate is exposed uniformly throughout the lift surface. The edges of the coarse aggregate shall not be undercut. The surface shall be washed clean again as the last operation prior to placing the next lift. There shall be no standing water on the surface upon which concrete is placed.

#### 3.2.4.2 Air-Water Cutting

Air-water cutting of a construction joint shall be performed at the proper time and only on horizontal construction joints. 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 by the Contracting Officer, a 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 applications. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure water jet or sandblasting will be required as the last operation before placing the next lift.

### 3.2.4.3 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 water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

### 3.2.4.4 Wet Sandblasting

This method may be used when the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. The surface of the concrete shall then be washed thoroughly to remove all loose materials.

### 3.2.4.5 Waste 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 be subject to approval.

## 3.3 PLACING

### 3.3.1 Placing Procedures

Construction joints and expansion joints for walls and slabs shall not exceed 35 ft, unless noted otherwise. Not less than 48 hours shall elapse between casting of adjoining units unless these requirements are waived by the contracting officer. The steel reinforcing shop drawings shall indicate the locations of all joints. The surfaces of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing concrete. Surfaces may be dampened immediately before placement if necessary. Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement and consolidation. 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 may be effectively consolidated in horizontal layers 2.0 feet or less in thickness with a minimum of lateral movement. The amount deposited in each location shall be that which can be readily and thoroughly consolidated. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of cold joints while concrete is being placed. Concrete shall be placed by methods that will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper that is conical in shape. The concrete shall not be dropped vertically more than 5 feet, except where a properly designed and sized elephant truck with rigid drop chute bottom section is provided to prevent segregation and where specifically authorized. In no case will concrete be discharged to free-fall through reinforcing bars.

### 3.3.2 Placement by Pump

When concrete is to be placed by pump, the nominal maximum-size coarse aggregate shall not be reduced to accommodate the pumps. The distance to

be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms. Grout used to lubricate the pumping equipment at the beginning of the placement will not be incorporated into the placement.

### 3.3.3 Time Interval Between Mixing and Placing

Concrete shall be placed within 30 minutes after discharge into nonagitating equipment. When concrete is truck-mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, 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 the aggregates. When the length of haul makes it impossible to deliver truck-mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site.

### 3.3.4 Cold-Weather Placing

When cold-weather placing of concrete is likely to be subjected to freezing temperatures before the expiration of the curing period, it shall be placed in accordance with procedures previously submitted in accordance with paragraph SUBMITTALS. The ambient temperature of the space adjacent to the concrete placement and surfaces to receive concrete shall be above 32 degrees F. The placing temperature of the concrete having a minimum dimension less than 12 inches shall be between 55 and 75 degrees F when measured in accordance with ASTM C 1064/C 1064M. The placing temperature of the concrete having a minimum dimension greater than 12 inches shall be between 50 and 70 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete-placing temperatures. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals, or other materials shall not be mixed with the concrete to prevent freezing.

### 3.3.5 Hot-Weather Placing

Concrete shall be properly placed and finished with procedures previously submitted in accordance with paragraph SUBMITTALS. The concrete-placing temperature shall not exceed 95 degrees F when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph WATER-REDUCING OR RETARDING ADMIXTURES may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

### 3.3.6 Consolidation

Immediately after placement, each layer of concrete, including flowing concrete, shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required, if necessary, with internal vibrating along formed surfaces permanently exposed to view. Form or surface vibrators shall not be used unless specifically approved. 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.

### 3.4 FINISHING

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 wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish. Additional finishing shall be as specified below and shall be true to the elevation shown in the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or as directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or jitterbugs shall not be used.

#### 3.4.1 Unformed Surfaces

##### 3.4.1.1 Float Finish

Surfaces shall be screeded and darbied 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. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true and even plane. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be made of magnesium or aluminum.

##### 3.4.1.2 Trowel Finish

A trowel finish shall be applied to the following surfaces: HFB, fishway. Concrete surfaces shall be finished with a float finish, and after surface moisture has disappeared, the surface shall be troweled to a smooth, even, dense finish free from blemishes including trowel marks.

##### 3.4.1.3 Broom Finish

A broom finish shall be applied to the following surfaces: access ramps, walking surfaces. The concrete surface shall be finished with a float finish. The floated surface shall be broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

#### 3.4.2 Formed Surfaces

Unless another finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired as described in paragraph FORMED SURFACE REPAIR.

TYPES OF FINISH	STRUCTURE OR PORTION OF STRUCTURE
Grout-cleaned	All surfaces exposed to view

Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that is exposed to view or on which a special finish is required. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.

#### 3.4.2.1 Grout-Cleaned Finish

The surfaces listed shall be given a grout-cleaned finish as described, as approved by the Contracting Officer and after all required curing, cleaning, and repairs have been completed. Surfaces to be grout-cleaned shall be moist cured for the required period of time before application of the grout-cleaned finish. Grout-cleaning shall be delayed until near the end of construction on all surfaces not to be painted in order to achieve uniformity of appearance and reduce the chance of discoloring caused by subsequent construction operations. The temperature of the air adjacent to the surface shall be not less than 40 degrees F for 24 hours prior to and 72 hours following the application of the finish. The finish for any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the finished surface. The surface to receive grout-cleaned finish shall be thoroughly wetted to prevent absorption of water from the grout but shall have no free water present. The surface shall then be coated with grout. The grout shall be applied as soon as the surface of the concrete approaches surface dryness and shall be vigorously and thoroughly rubbed over the area with clean burlap pads, cork floats or stones, so as to fill all voids. The grout shall be composed of one part portland cement as used on the project, to two parts by volume of well-graded sand passing a 600- $\mu$ m (No. 30) sieve mixed with water to the consistency of thick paint. White portland cement shall be used for all or part of the cement as approved by the Contracting Officer to give the desired finish color. The applied coating shall be uniform, completely filling all pits, air bubbles, and surface voids. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, burlap pad, or other means. Then, after the surface whitens from drying (about 30 minutes at normal temperature) rub vigorously with clean burlap pads. Immediately after rubbing is completed, the finished surface shall be continuously moist cured for 72 hours. Burlap pads used for this operation shall be burlap stretched tightly around a board to prevent dishing the mortar in the voids.

#### 3.4.3 Formed Surface Repair

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

##### 3.4.3.1 Classes A, AHV, & B Finishes

Surfaces listed in Section 03100A STRUCTURAL CONCRETE FORMWORK and as shown to have classes A, AHV, and B finishes shall have surface defects

repaired as follows: defective areas, voids, and honeycombs smaller than 16 square inches in area and less than 1/2 inch deep and bug holes exceeding 1/2 inch in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of tie rods shall be reamed and filled with dry-packed mortar as specified in paragraph MATERIAL AND PROCEDURE FOR REPAIRS. Defective and unsound concrete areas larger than described shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

#### 3.4.3.2 Class C Finish

Surfaces listed in Section 03100A STRUCTURAL CONCRETE FORMWORK and as shown shall have defects repaired as follows: defective areas, voids, and honeycombs smaller than 24 square inches and less than 2 inches deep; bug holes exceeding 1-1/2 inches in diameter shall be chipped and filled with dry-packed mortar; and holes left by removal of the tie rods shall be chipped and filled with dry-packed mortar. Defective and unsound concrete areas larger than 24 square inches and deeper than 1-1/2 inches shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

#### 3.4.3.3 Class D Finish

Surfaces listed in Section 03100A STRUCTURAL CONCRETE FORMWORK and as shown to have class D finish shall have surface defects repaired as follows: defective areas, voids, and honeycombs greater than 48 square inches in area or more than 2 inches deep shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

#### 3.4.3.4 Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used 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 used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes 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 match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Contracting Officer. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. Metal tools shall not be used to finish permanently exposed 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 40 degrees F during placement, finishing, and curing. Other methods and materials for repair may be used only when approved in writing by the Contracting Officer. Repairs of the so called "plaster-type" will not be permitted.

### 3.5 CURING AND PROTECTION

#### 3.5.1 Moist Curing

Moist-cured concrete shall be maintained continuously, not periodically, wet for the entire curing period. If water or curing materials stain or discolor concrete surfaces that are to be permanently exposed, they shall be cleaned as required in paragraph APPEARANCE. Where wooden form sheathing is left in place during curing, the sheathing shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be carefully broken loose from the concrete, soon after the concrete hardens, and curing water continuously applied into the void so as to continuously saturate the entire concrete surface. Horizontal surfaces may 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. Horizontal construction joints may be allowed to dry for 12 hours immediately prior to the placing of the following lift. Silica fume concrete, if used, shall be moist-cured. Curing of silica fume concrete shall start immediately after placement.

#### 3.5.2 Membrane-Forming Curing Compound

Concrete may be cured with an approved membrane-forming curing compound in lieu of moist curing except that membrane curing will not be permitted on any surface to which a grout-cleaned finish is to be applied or other concrete is to be bonded, on any surface containing protruding steel reinforcement, on an abrasive aggregate finish, or any surface maintained at curing temperature by use of free steam. A styrene acrylate or chlorinated rubber compound may be used for surfaces that are to be painted or are to receive bituminous roofing or waterproofing, or for floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified.

##### 3.5.2.1 Application

The curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. 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

and bleeding has stopped. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces that have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. 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 cause that will disrupt the continuity of the curing membrane.

### 3.5.3 Evaporation Retardant

The following concrete surfaces may be cured using sheet material: Slabs greater than 12" thick. Sheet curing shall not be used on vertical or near-vertical surfaces. All surfaces shall be thoroughly wetted and be completely covered with waterproof paper or polyethylene-coated burlap having the burlap thoroughly water-saturated before placing. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or 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.

### 3.5.4 Cold-Weather Curing and Protection

When the daily outdoor low temperature is less than 32 degrees F, the temperature of the concrete shall be maintained above 40 degrees F for the first 7 days after placing. In addition, during the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by observation of ambient and concrete temperatures indicated by suitable temperatures measuring devices furnished by the Government as required and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor at such locations as may be directed.

## 3.6 TESTS AND INSPECTIONS

Tests and inspections shall conform to the following requirements.

### 3.6.1 General

The Contractor shall perform the inspections and tests described below, 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 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 individuals who perform the inspection of concrete construction shall have

demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Construction Inspector (CCI). The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077.

### 3.6.2 Testing and Inspection Requirements

#### 3.6.2.1 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 and COE CRD-C 104 for the fine aggregate or for each size range of 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.

b. Corrective Action for Fine Aggregate Grading - When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Contracting Officer.

c. 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 the 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.

d. 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) if necessary to maintain the specified slump.

#### 3.6.2.2 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 which are coarser than the specification limits for samples taken at locations other than as delivered to the mixer to allow for degradation during handling.

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 to the Contracting Officer. Where two consecutive averages of five tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

c. Coarse Aggregate Moisture Content - A test for moisture content of each size group of coarse aggregate shall be made at least twice per week. 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 above for fine aggregate, until the difference falls below 1.0 percent.

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 if necessary to maintain the specified slump.

#### 3.6.2.3 Quality of Aggregates

a. Frequency of Quality Tests - Thirty days prior to the start of concrete placement the Contractor shall perform all tests for aggregate quality listed below. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality in accordance with the frequency schedule shown below. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

PROPERTY	FINE AGGREGATE	FREQUENCY		TEST
		FINE AGGREGATE	COARSE AGGREGATE	
Specific Gravity	Every 3 months	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Absorption	Every 3 months	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Impurities	Every 3 months	Not applicable	Not applicable	ASTM C 40 ASTM C 87

b. Corrective Action for Aggregate Quality - If the result of a quality test fails to meet the requirements for quality 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 to the Contracting Officer and immediate steps taken to rectify the situation.

#### 3.6.2.4 Scales

a. Weighing Accuracy - The accuracy of the scales shall be checked by

test weights prior to start of concrete operations and at least once every 3 months for conformance with the applicable requirements of paragraph BATCHING 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 BATCH PLANT for checking the accuracy of dispensed admixtures are operating properly.

#### 3.6.2.5 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.

#### 3.6.2.6 Concrete Mixture

a. Air Content Testing - Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government quality assurance representative. Tests shall be made in accordance with ASTM C 231. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single test result reaches either the upper or lower action limit a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the control chart for air content and the control chart for range, and for determining the need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph AIR CONTENT. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a control chart for range where an upper warning limit is set at 2.0 percentage points and upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the



stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the air content at the mixer controlled as directed.

b. Air Content Corrective Action - Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as is practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the control chart range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted. All this shall be at no extra cost to the Government.

c. Slump Testing - In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government's quality assurance representative. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made on the same batch of concrete. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control chart for percent air and the chart for range, and for determining the need for any remedial action. An upper warning limit shall be set at 1/2 inch below the maximum allowable slump on separate control charts for percent air used for each type of mixture as specified in paragraph SLUMP, and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 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 mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the slump at the mixer controlled as directed.

d. Slump Corrective Action - Whenever points on the control chart for slump reach the upper warning limit, an adjustment shall be immediately made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum W/C specified, based upon aggregates which are in a saturated surface-dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be

delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted and the Contractor shall take appropriate steps to bring the slump under control. Also, additional slump tests shall be made as directed. All this shall be at no additional cost to the Government.

e. Temperature - The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Compressive-Strength Specimens - At least one set of test specimens shall be made each day on each different concrete mixture placed during the day. Additional sets of test cylinders shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A random sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph DESIGN REQUIREMENTS shall consist of four cylinders, two to be tested at 7 days and two at 28 days. A set of test specimens for concrete with a 90-day strength per specified paragraph DESIGN REQUIREMENTS shall consist of six cylinders, two tested at 7 days, two at 28 days, and two at 90 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. All compressive-strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength tests, moving average for strength, and moving average for range for each mixture. The charts shall be similar to those found in ACI 214R.

#### 3.6.2.7 Inspection Before Placing

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

#### 3.6.2.8 Placing

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 batching and 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.

#### 3.6.2.9 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 at the same time the vibrator is operating in concrete with the tachometer 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 VIBRATORS shall be immediately removed from service and repaired or replaced.

#### 3.6.2.10 Curing

a. **Moist-Curing Inspections** - At least once each shift, and once 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 curing, immediate corrective action shall be taken, and the required curing period for such 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 material 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.

#### 3.6.2.11 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 deficiencies that 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.

#### 3.6.2.12 Cold-Weather Protection Corrective Action

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

#### 3.6.2.13 Mixer Uniformity

a. Stationary Mixers - Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the longest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers - Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

#### 3.6.2.14 Mixer Uniformity Corrective Action

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

#### 3.6.3 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 test and inspection records.

-- End of Section --

## SECTION 05500

## MISCELLANEOUS METAL FABRICATIONS

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ALUMINUM ASSOCIATION (AA)

- |           |  |
|-----------|--|
| AA 46     | (1978) Standards for Anodized Architectural Aluminum |
| AA DAF-45 | (2003) Designation System for Aluminum Finishes      |

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- |          |  |
|----------|--|
| AISC 303 | (2000) Code of Standard Practice for Steel Buildings and Bridges |
|----------|--|

## AMERICAN WELDING SOCIETY (AWS)

- |                |  |
|----------------|--|
| AWS D1.1/D1.1M | (2004) Structural Welding Code - Steel |
|----------------|--|

## ASME INTERNATIONAL (ASME)

- |               |                                   |
|---------------|-----------------------------------|
| ASME B18.21.1 | (1999) Lock Washers (Inch Series) |
| ASME B18.22.1 | (1965; R 2003) Plain Washers      |

## ASTM INTERNATIONAL (ASTM)

- |                   |   |
|-------------------|---|
| ASTM A 123/A 123M | (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 153/A 153M | (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware             |
| ASTM A 36/A 36M   | (2008) Standard Specification for Carbon Structural Steel                                       |
| ASTM A 47/A 47M   | (1999) Ferritic Malleable Iron Castings   |
| ASTM A 500        | (2003) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes      |
| ASTM A 53         | (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless                     |

ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 924/A 924M	(2004) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 108	(2003a) Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(2004) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2004a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 26/B 26M	(2003) Aluminum-Alloy Sand Castings
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 488	(1996; R 2003) Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Jan 2004) Alkyd Anti-Corrosive Metal Primer
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM PR	(2001) Pipe Railing Manual
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; R 2000) Power Tool Cleaning
SSPC SP 6	(2000) Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders
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## 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-02 Shop Drawings

Fabrication drawings of steel stairs; G  
Handrails, installation drawings; G  
Ladders, installation drawings; G  
Embedded angles and plates, installation drawings; G

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

#### SD-03 Product Data

Handrails  
Ladders

### 1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

### 1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Structural Carbon Steel

ASTM A 36/A 36M.

#### 2.1.2 Structural Tubing

ASTM A 500.

#### 2.1.3 Steel Pipe

ASTM A 53, Type E or S, Grade B.

#### 2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47/A 47M.

#### 2.1.5 Anchor Bolts

ASTM F1554. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

##### 2.1.5.1 Adhesive Anchors

Unless noted otherwise, provide 3/4in. diameter adhesive anchors. Minimum concrete embedment shall be 6in. Design values listed shall be as tested according to ASTM E 488.

#### 2.1.5.2 Washers

Provide plain washers to conform to ASME B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

#### 2.1.6 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

### 2.2 FABRICATION FINISHES

#### 2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123/A 123M, ASTM A 153/A 153M, ASTM A 653/A 653M or ASTM A 924/A 924M, G90, as applicable.

#### 2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

#### 2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

#### 2.2.4 Shop Cleaning and Painting

##### 2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

##### 2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.



### 2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

### 2.2.6 Aluminum Surfaces

#### 2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

#### 2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF-45, or AA 46. Unless otherwise specified, all other aluminum items shall have anodized finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish.

### 2.3 HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 50 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM PR, provide the same size rail and post. Refer to the contract drawings for details.

#### 2.3.1 Steel Handrails, Including Carbon Steel Inserts

Provide steel handrails, including inserts in concrete, structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Provide steel railings of 1 1/2 inches nominal size. Railings to be hot-dip galvanized.

- a. Fabrication: Joint posts, rail, and corners by one of the following methods:

- (1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

- (2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.

- (3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

### 2.4 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Rungs to be not less than 16 inches wide, spaced one foot

apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts as indicated. Provide intermediate clip angles not over 48 inches on centers.

#### 2.4.1 Ladder Cages

Conform to 29 CFR 1910.27. Fabricate 2 by 1/4 inch horizontal bands and 1 1/2 by 3/16 inch vertical bars. Provide attachments for fastening bands to the side rails of ladders or directly to the structure. Provide and fasten vertical bars on the inside of the horizontal bands. Extend cages not less than 27 inches or more than 28 inches from the centerline of the rungs, excluding the flare at the bottom of the cage, and not less than 27 inches in width. Clear the inside of the cage of projections.

#### 2.5 MISCELLANEOUS PLATES AND SHAPES

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123/A 123M.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

#### 3.2 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

#### 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items

securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

### 3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

### 3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

### 3.6 FINISHES

#### 3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

#### 3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

#### 3.6.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

### 3.7 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

### 3.8 HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

## 3.9 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 3/4 inch diameter adhesive bolts. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the concrete. In no case shall ends of ladders rest upon floor.

-- End of Section --

## SECTION 05502

## MISCELLANEOUS METAL

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D (2002) Structural Welding Code - Steel

## ASTM INTERNATIONAL (ASTM)

ASTM A 36 (2003a) Carbon Structural Steel

ASTM A 53 (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 123 (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 320 (2003) Alloy/Steel Bolting Materials for Low-Temperature Service

ASTM A 500 (2003) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 653 (2003) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 865 (2003) Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints

ASTM A 924 (1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 32 (2003) Solder Metal

ASTM F 844 (2000) Washers, Steel, Plain (Flat), Unhardened for General Use

## 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 "RE" designates

that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

##### Miscellaneous Metal Items.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: Flap Gate and Debris Rack.

#### SD-11 Closeout Submittals

##### 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.

### 1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1/D. All metal material used for Gates, Flap Gates and Debris Racks shall be galvanized and shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 653, or ASTM A 924, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

### 1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

### 1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in

place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

#### 1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 General

Materials indicated on the drawings or required in the work and not covered elsewhere by detailed requirements shall conform to the requirements of this section. In all cases not specifically covered in these specifications, the Contractor shall furnish approved highest grade commercial materials or products which are suitable for the intended use of the item.

##### 2.1.2 Structural Shapes and Plates

Steel bars, shapes and plates shall conform to ASTM A 36. Galvanized coatings where required, shall conform to ASTM A 123.

##### 2.1.3 Steel Pipes

Steel pipe shall be zinc-coated steel pipe conforming to the requirements of ASTM A 53, Standard Weight, Schedule 40, nominal size unless noted otherwise.

##### 2.1.4 Flap Gates and Debris Rack and Appurtenances

Flap Gates and Debris Rack and appurtenances shall be fabricated as shown on the drawings. Flap Gates and Debris Rack shall be fabricated in the shop from standard weight steel pipe conforming to ASTM A 53 or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Flap Gates and Debris Rack shall be 1-1/2 inch nominal size and all pipe access gate components (including nuts and washers) shall be hot-dip galvanized after fabrication. Welded, cut, damaged, and deformed areas of galvanizing metal shall be neatly coated with Grade 50B solder conforming to ASTM B 32. Pipe collars shall be hot-dip galvanized steel.

##### 2.1.5 Pipe Caps

Pipe caps shall conform to commercially available heavy duty pipe caps.

##### 2.1.6 Pipe, Steel, Fittings

Steel, fittings, shall conform to ASTM A 865 as necessary.

##### 2.1.7 Corrosion-Resisting Steel Bolts and Anchor Bolts

Corrosion-resisting steel bolts and anchor bolts shall conform to the

applicable requirements of ASTM A 320, Grade B8.

#### 2.1.8 Bolts

Bolts and anchor bolts shall conform to the applicable requirements of ASTM A 320, Grade B8.

#### 2.1.9 Nuts

Nuts shall be galvanized and confirm to the applicable requirements of ASTM A 320, Grade 8. Nuts shall be galvanized.

#### 2.1.10 Concrete, Mortar and Grout

Concrete, motar and grout shall conform to the requirements of Section 03301A CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

#### 2.1.11 Washers

Washers shall confirm to ASTM F 844. Washers shall be galvanized.

### 2.2 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

### 2.3 DELETED

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified. Contractor shall submit detailed drawings of miscellaneous metal items. Detail drawings shall indicate material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: Flap Gates and Debris Rack.

### 3.2 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Steel with welds will not be accepted, except where welding is definitely specified or called for on the drawings. All bolts, nuts, and screws shall be tight. Work shall be accurately set to established lines and elevations and securely fastened in place. Anchorage shall be provided where necessary for fastening miscellaneous metal and wood items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; machine and carriage bolts for steel; and lag bolts and screws for wood.



### 3.3 FINISHING

In general, tolerances for machine-finished surfaces designated by nondecimal dimensions shall be within 0.016 inch. Sufficient machining stock shall be allowed on placing pads to insure true surfaces of solid material. Finished contacts of bearing surfaces shall be true and exact to secure full contact. All drilled holes for bolts shall be accurately located and drilled from templates.

### 3.4 ZINC COATING (GALVANIZING)

Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A 123. All exposed ferrous metalwork, except cast-iron and corrosion resistant steel and items to be completely embedded in concrete, shall be galvanized unless other protective coatings are specified. Metalwork shall be galvanized after fabrication. In the event that any portion of galvanized metalwork is abraded or otherwise damaged to the extent that the base metal is exposed, such damaged or abraded portions shall be neatly covered with Grade 50B solder conforming to the requirements of ASTM B 32.

### 3.5 WELDING

Welding shall conform to the provisions of AWS D1.1/D. Welders who have not been certified within two years of the date of commencement of work under this contract will not be allowed to perform the work.

### 3.6 BOLTED CONNECTIONS

Bolt holes shall be reamed normal to the member and shall be truly cylindrical throughout. Unless otherwise specified, holes for bolts shall not be more than 0.063 inch larger than the diameter of the bolt. Cutting bolt holes with a torch will not be permitted without the prior written approval of the Contracting Officer. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable.

### 3.7 CLEANUP

Upon completion of the installation of pipe sleeves and appurtenances, all debris and surplus materials resulting from the work shall be removed.

### 3.8 SATISFACTORY INSTALLATION

The contractor shall submit a Satisfactory Installation statement signed by the principal officer of the contracting firm stating that the installation of the pipe sleeves 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.

-- End of Section --

## SECTION 05505

## STRUCTURAL METAL FABRICATIONS

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (2006) Recommended Practice

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.5M/D1.5 (2008; Errata 2009) Bridge Welding Code

AWS QC1 (2007) AWS Certification of Welding Inspectors

## ASME INTERNATIONAL (ASME)

ASME B4.1 (1967; R 2004) Preferred Limits and Fits for Cylindrical Parts

ASME B46.1 (2002) Surface Texture (Surface Roughness, Waviness and Lay)

## ASTM INTERNATIONAL (ASTM)

ASTM A 325 (2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A 709/A 709M (2009) Standard Specification for Structural Steel for Bridges

ASTM E 165 (2009) Standard Test Method for Liquid Penetrant Examination

ASTM E 709 (2008) Standard Guide for Magnetic Particle Examination

ASTM F 436 (2009) Hardened Steel Washers

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual

## 1.2 SYSTEM DESCRIPTION

Provide a detailed Work Plan for fabrication, including descriptions of shop facilities, equipment, number of personnel, and related information prior to the Pre-fabrication Conference, and procedures for safe conduct of the work, careful removal and disposition of materials, protection of property that is to remain undisturbed, and coordination with other work in progress. Include in the procedures a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1. The fabrication of the tainter gate structures under this contract shall be performed according to this section of the specifications:

- a. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and approved. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, and welder, welding operator, and tacker performance qualifications.
- b. As it is used in these specifications, "The Engineer" refers to the District engineer of record. The AWS D1.5M/D1.5 definition of "The Engineer" as specified in AWS D1.5M/D1.5 section 1.1.3 shall refer to the District engineer of record in lieu of the state bridge engineer as specified in section 1.1.3 of AWS D1.5M/D1.5.
- c. Schedule a Prefabrication Conference as soon as possible after Notice to Proceed and prior to any fabrication. The Prefabrication Conference shall include, at a minimum, the Prime Contractor, Fabricator, the Fabricator's primary QC representative, the COR, the GQAR, and the Engineer of record for the structure or structures being fabricated. The Prefabrication Conference shall occur either at the Fabrication Facilities or a similar location as deemed appropriate.

### 1.2.1 Weld Tracking Log Template

Submit for approval a weld tracking log template, a minimum of 30 days prior to commencement of fabrication, to identify all necessary components to be addressed in the tracking of all welds for the structures in question. A weld-tracking log will be developed and maintained as described in the following paragraphs.

### 1.2.2 Weld Tracking Log

Provide a log capable of individually identifying and tracking every weld on the project. Member identification shall follow the numbering scheme shown on the shop drawings. The log shall include the member to be welded, member type (FCM and Non-FCM), type of weld including temporary and tack welds, welding position, applicable WPS reference, AWS joint preparation designation, name or stamping designation of welder, welding operator or tacker, date and time of completion of welding and/or tacking, name and date of CWI visual inspection, NDT testing performed, including the type of inspection, date(s) of inspection, inspector name, and the acceptance criteria used, description of defects found and reason for non-compliance, corrective action taken, or whether the weld is acceptable. Weld identification on the shop drawing shall match weld tracking log

identification. A completed log shall be bound together for each structure and two copies shall be submitted to the Contracting Officer immediately upon completion of the fabrication of each structure. Draft copies of NDT testing shall be furnished to the Contracting Officer upon request and shall be available on the shop floor during any inspection.

#### 1.2.3 Welding Procedure Specifications (WPS)

Submit a Welding Procedure Specification (WPS) for each weld, including prequalified welds, in accordance with paragraph Welded Connections approved before fabrication is commenced. Welding Procedure Specifications shall be individually identified and shall be referenced on the shop drawings. In case of conflict between this specification and AWS D1.5M/D1.5 as applicable, this specification governs.

#### 1.2.4 Fracture Critical Members (FCM)

FCM are shown on the Contract Drawings and include all attachments and connections to these members as defined in AWS D1.5M/D1.5. All materials to be welded shall be ASTM A 709/A 709M, grade as specified or shown on the drawings, using killed fine-grain mill practice, unless otherwise shown or specified. Mill repairs of base metal are prohibited. Toughness shall meet the requirements of ASTM A 709/A 709M, Table 10, for Zone 2, unless otherwise indicated or specified. All materials used for the construction of fracture critical components shall meet the requirements of section 10 of ASTM A 709/A 709M and shall include mill certification showing that the material meets the necessary toughness requirements. Welding for fracture critical members shall meet all requirements of AWS D1.5M/D1.5 Section 12, including:

- a. Welding Processes. All procedures shall be qualified as required.
- b. Consumable Requirements. All welding consumables shall be heat or lot-tested by the manufacturer to determine conformance with the requirements of the Fracture Control Plan (FCP). Exceptions are not allowed. Toughness test results shall meet the values specified in Table 12.1 of AWS D1.5M/D1.5.
- c. Welding Procedure Specifications (WPS). All procedures, including repair welds, shall be prequalified or qualified by test as required and documented in the WPS and Procedure guidelines of AWS D1.5M/D1.5.
- d. Certification and Qualification. Welders and welding operators shall meet the applicable requirements of AWS D1.5M/D1.5.
- e. Material handling and preparation, including thermal cutting, preparation of base metal, and straightening, curving, cambering shall meet the applicable requirements.
- f. Tack Welds and Temporary Welds. All welds shall be located within the joint and shall meet the requirements of AWS D1.5M/D1.5, Table 12.2. Temporary welds on FCM are not permitted.
- g. Welding processes, including preheat, interpass temperatures, and postweld thermal treatment shall meet the applicable requirements.
- h. Weld Inspection. The Quality Control inspection program shall be documented in the FCP. All inspectors and NDT technicians shall be qualified as required. All butt joints shall be tested with UT and

RT. Inspection procedures and documentation are as specified in the applicable sections of AWS D1.5M/D1.5. Cooling times must be strictly adhered to.

- i. Repair Welding. Repair welds must be classified as "critical repairs" or "non-critical repairs" for all repair welding. Repair procedures shall follow the minimum provisions unless specified otherwise. Repair procedures must be qualified and approved and subject to the same QA/QC inspection requirements as other welds. Minimum preheat for repair welding shall be as defined in AWS D1.5M/D1.5 section 12.17.6. All weld repairs to fracture critical members shall be considered critical welds in accordance with AWS D1.5M/D1.5 Section 12.17.3 and shall be approved by the engineer of record.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only.

#### SD-01 Preconstruction Submittals

##### Welding Procedure Specifications (WPS); G

A WPS for all welds applicable to work under this Contract. All WPS shall be submitted with attached PQR and supporting test documentation on forms similar or equivalent to the sample forms in AWS D1.5M/D1.5, Annex III.

##### Fracture Control Plan (FCP); G

A Fracture Control Plan (FCP) for welding on all Fracture Critical Members (FCM) in accordance with AWS D1.5M/D1.5, Section 12. Welding Procedures, qualifications, and certifications shall be submitted showing compliance with FCP requirements

##### Weld Tracking Log Template; G

A weld tracking log template for approval, a minimum of 30 days prior to commencement of fabrication.

#### SD-02 Shop Drawings

##### Shop Drawings; G

Prior to performing any fabrication of the HSS structures listed in paragraph System Description above, complete, detailed shop drawings to the Contracting Officer and Engineer of Record for approval. Shop drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences. Shop drawings shall include catalog cuts, templates, fabrication and assembly details, and type, grade, and class of materials, as appropriate. All FCM, including attachments that meet the FCM definition, shall be identified on the shop drawings. All temporary and tack welds shall be identified on the shop drawings. Each member shall be identified following the numbering scheme shown on the drawings. A table shall be provided containing a list of all members and a reference to each material certificate and test report that applies to that member. Shop drawings shall identify weld procedures and NDE required for each

weld. Any and all splices shall be included in the shop drawings and clouded for engineer approval.

#### Assembly; G

Assembly Drawings indicating the sequence of fabrication and assembly and providing details for connecting the adjoining fabricated components in the shop.

#### Welding Repairs - Non-Fracture Critical Members; G

Welding Repair plans for steel, approved prior to making repairs. Welding repair plans shall address weld repairs within the weld as well as weld repairs for base metal discontinuities.

#### Welding Repairs - Fracture Critical Members; G

Welding Repair plans for fracture critical weld repairs approved prior to making repairs. Welding repair plans shall address weld repairs within the weld as well as weld repairs for base metal discontinuities.

#### Delivery/Shipping Plan; G

Drawings providing descriptions of methods of delivering the completed structural units, including details for support during shipment to prevent distortion or other damages, and orientation and location of the structure on transport equipment.

### SD-03 Product Data

#### Materials Disposition Record

Three copies of all purchase and mill orders, shop orders for materials and work orders, including all new orders placed by Contractors and old orders extended for each supplier. Furnish, at the time of submittal of shop drawings, a list designating the material to be used for each item. Additional requirements for this submittal are listed below.

### SD-06 Test Reports

#### Certified Test Reports; G

Reports of tests, inspections, and verifications of all materials used under this contract approved by the Government before incorporation into the structure. All steel used in this contract shall be tested by an approved U.S. laboratory to ensure that it meets the required standards.

#### Weld Tracking Log; G

A weld-tracking log as specified.

#### Witness Points

A detailed schedule showing the progression of work and completion of components.

## SD-07 Certificates

## Work Plan; G

A detailed plan for fabrication, including descriptions of shop facilities, equipment, number of personnel, and related information prior to the Pre-fabrication Conference. The Work Plan shall include the recommended measuring system for ensuring dimensional tolerances.

## Qualification of Welders and Welding Operators; G

Certifications for welders and welding operators prior to commencing fabrication. Welder and welding operator qualification test records shall be submitted on forms similar or equivalent to the sample forms in AWS D1.5M/D1.5, Annex III. All welders performing fracture critical welds under this specification shall be qualified according to Section 12 of AWS D1.5M/D1.5. All welders performing non fracture critical welds shall be qualified according to Section 6 of AWS D1.5M/D1.5. All qualifications shall be current prior to commencing any work. Submit a log for each welder showing that he/she is current in the process and procedures being proposed for this work.

## Inspector Qualifications; G

Copies of certificates showing evidence of qualifications or certifications for welding inspectors and NDT personnel.

## Qualification of Structural Steel Fabricator; G

Copies of certificates showing the fabrication plant meets the specified structural steelwork category.

## 1.4 QUALITY ASSURANCE

Establish Witness Points for the Initial QA Inspection, Intermediate QA Inspections, and Final Inspection as follows. Start the Initial QA Inspection after the Government has determined that there is substantial completion of components that comprise a reasonable sampling of each significant FCM and non-FCM details. The extent of completion and details and the date of the Initial QA Inspection shall be determined at the Prefabrication Conference by the Government after discussion with the Contractor. At that time, produce a detailed schedule showing the progression of work and completion of components. This schedule will be updated weekly and provided by e-mail to the Contracting Officer. Give the Contracting Officer two weeks notice prior to the predetermined date for the Initial QA Inspection, including adjustments for changes in schedule. Intermediate QA Inspections will be conducted on an as needed basis and at the discretion of the Government. All QA inspections will follow AWS D1.5M/D1.5 and AASHTO/NSBA Steel Bridge Collaboration S 4.1 - 2002 Steel Bridge Fabrication QC/QA Guide Specification. Provide unpainted components for each QA NDT and Visual Inspection. At these stages of construction, give the Contracting Officer three working days to inspect the structure. The QA Inspection period shall not commence until after a minimum period of 72 hours after any welding. After the Contracting Officer and the Engineer of Record has inspected the structure, make any changes required to the structure as directed by the Contracting Officer before proceeding with any additional welding. Proceed with the

construction until the next witness point is reached, unless it is waived in writing by the Contracting Officer. Each structure fabricated is subject to a Final Fabrication Inspection prior to painting. A Final Fabrication Inspection shall be conducted after the first structure is completed. Final Fabrication Inspections of additional structures shall be scheduled and coordinated with the Contracting Officer and the Engineer of Record. Give the Contracting Officer a minimum notice of two weeks prior to the Final Fabrication Inspection.

#### 1.4.1 Qualification of Welders and Welding Operators

Submit welder, welding operator and tacker qualification certification for each welder, welding operator or tack welder to the Government Representative/Contracting Officer/ Engineer and approved before fabrication is commenced in accordance with paragraph Welded Connections. A CWI meeting the specified qualifications shall approve all welder qualifications. Welders, welding operators, and tack welders shall be limited to welding procedures for which they are certified. Test welds shall be prepared, welded, and tested in accordance with the requirements of AWS D1.5M/D1.5. Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept current for the duration of the contract.

#### 1.4.2 Inspector Qualifications

All inspectors, performing structural steel inspection in accordance with these specifications, shall be qualified and certified in conformance with AWS QC1. Provide an AWS Certified Welding Inspector (CWI) as the primary point of contact for quality control of welding. When several CWI and NDT technicians are working, one primary individual shall be designated as having primary responsibility for all quality control in accordance with AWS D1.5M/D1.5 Section 6.1.2.2. Non-certified inspectors and certified associate weld inspectors (CAWI) shall not be used for inspection under these specifications. All personnel who perform NDT shall be qualified in accordance with: ASNT RP SNT-TC-1A NDT Level II or III. All personnel performing NDT shall be supervised by personnel possessing a Level III ASNT NDT certification in accordance with AWS D1.5M/D1.5 section 6.1.3.4 and section 12.16.1.2.

#### 1.4.3 Qualification of Structural Steel Fabricator

The fabricating plant and fabricator shall be certified under the AISC (American Institute of Steel Construction) Quality Certification Program, Category III, Major Steel Bridges (CBR) category with Fracture Critical endorsement (F) and shall possess five 5 years documented experience on projects of similar scope. Similar scope means projects of similar size and similar amounts of welding and detail types. Submit copies of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category and documented experience.

#### 1.4.4 Testing by the Government

Material component parts may be subjected to any form of nondestructive



testing, as directed by the Contracting Officer. This may include ultrasonic, magnetic partial, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Government. Any defects will be cause for rejection and rejected materials or parts shall be replaced and retested at the Contractor's expense.

#### 1.4.5 Shop Drawings

Prepare all shop drawings using a Registered Professional Engineer or under the direct supervision of a Registered Professional Engineer. Elements of fabricated items inadvertently omitted on contract drawings shall be returned to the Engineer of Record for detailing or shall be detailed by the fabricator and so indicated on the shop drawings. Any and all details developed by the fabricator shall be clouded on the shop drawings for separate approval by the Engineer of Record. Any items designed by the Contractor shall be prepared and sealed by a Registered Professional Engineer. No splices shall be included in the structure without approval of the Engineer of Record. All field welds required shall be identified on the shop drawings. Each weld, both shop and field welds, required shall be provided a unique identifier to permit tracking on the weld tracking log.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Notify the Contracting Officer at least 28 days in advance of delivery of the structures. Shipping of the structures shall be at the Contractor's expense. Contractor coordination for delivery shall be through the Los Angeles District Contracting Officer. The structures shall be arranged on the delivery vehicles such that no damage occurs during shipping. Submit a Delivery/Shipping Plan showing orientation and locations of structures on the delivery vehicles prior to shipment for Government approval.

### PART 2 PRODUCTS

#### 2.1 FABRICATION

##### 2.1.1 Structural Fabrication

Material shall be straight before being laid off or worked. If straightening is necessary, it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material, other than structural steel, shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown. Re-entrant cuts shall be filleted round to a minimum radius of 1 inch in accordance with AWS D1.5M/D1.5 section 3.2.4 unless otherwise indicated or approved. Finished members shall be free of twists, bends and open joints.

##### a. Dimensional Tolerances for Structural Work.

- (1) Dimensions shall be measured by an approved measuring system.  
Submit the measuring system for approval with the work plan (i.e.

calibrated steel tape of approximately the same temperature as the material being measured). The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified for the item of work. Where tolerances are not specified in other sections of these specifications or shown, a variation of 1/32 inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown by not more than 1/16 inch for members 30 feet or less in length and by not more than 1/8 inch for members over 30 feet in length.

- (2) Structure dimensions indicated on the drawings are based on a structure temperature of 70 degrees F. The Contractor is responsible for any and all dimensional adjustments to compensate for actual temperature variations during construction.

- b. Structural Steel Fabrication. Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges shall be prepared in accordance with AWS D1.5M/D1.5, Subsection 3.2. Hand-guided cuts shall be chipped, ground or machined to sound metal.

#### 2.1.2 Assembly

Provide Assembly Drawings indicating the sequence of fabrication and assembly and provide details for connecting the adjoining fabricated components in the shop. Assembly details shall identify the required order of assembly and details of witness points as described in these specifications.

#### 2.1.3 Materials Disposition Record

Furnish the Contracting Officer three copies of all purchase and mill orders, shop orders for materials and work orders, including all new orders placed by Contractors and old orders extended for each supplier. Furnish, at the time of submittal of shop drawings, a list designating the material to be used for each item. Where mill tests are required, purchase orders shall contain the test site address and the name of the testing agency. Furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site, giving the designation mark and weight of each piece, the number of pieces, the total weight, and if shipped by rail in carload lots, the car initial and number. Submit material records before the beginning of fabrication.

#### 2.1.4 Welded Connections

- a. Welding Procedure.

- (1) Welding shall conform to the applicable provisions of AWS D1.5M/D1.5. Prior to the start of production welding, submit a complete schedule of welding procedures for a typical structure. The schedule shall conform to the requirements specified in the provisions of AWS D1.5M/D1.5. The schedule shall provide detailed procedure specifications and tables or diagrams showing the procedures to be used for each required joint.

- (2) Submit to the Government Representative/Contracting Officers

Representative/Engineer, a Welding Procedure Specification for each weld to be made. Submit Welding Procedure Specifications and Procedure Qualification Records (PQR) to the Government Representative/Contracting Officer for approval before fabrication is commenced. Copies of the Welding Procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Submit the WPS and PQR with the shop drawings. Each WPS shall be prepared and qualified in accordance with the applicable provisions of AWS D1.5M/D1.5. Welding procedures shall show types and locations of welds designated or specified to receive nondestructive examination and identify the weld as FCM when applicable. A WPS is always required, even if the procedure is considered prequalified in accordance with AWS D1.5M/D1.5. Properly documented evidence of compliance with all requirements of these specifications for previous qualification tests shall establish the welding procedure as prequalified. Each procedure shall be clearly identified as being either prequalified or qualified by tests. If a PQR is performed, a representative of the Government shall witness the test plate welding and the specimen testing. Approval of any procedure, however, will not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications. Copies of the WPS shall be made available for reference to the welders, welding operators and tack welders. A CWI meeting the specified qualifications shall approve all WPS's and PQR's.

- b. Welder Performance Qualification of Welders and Welding Operators. Welding operators, welders, and tack welders shall be qualified and requalified if necessary for the particular type of work to be done. Qualification shall be in accordance with AWS D1.5M/D1.5. Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Copies of the Performance Qualification records shall be submitted to the Government Representative and approved before fabrication is commenced. Require the welder and welding operators to repeat the qualifying tests when, in the opinion of the Government Representative/Contracting Officer's Representative/Engineer, the work indicates a reasonable doubt as to proficiency. In such cases, the welder shall be recertified, as above, after successfully passing the retest; otherwise, he/she shall be disqualified until successfully passing a retest. The period of effectiveness for all welder and welding operator performance qualifications shall be in accordance with AWS D1.5M/D1.5. Keep the certification current for the duration of the contract. All expenses in connection with qualification and requalification shall be borne by the Contractor.
- c. Welding Process. Welding of structural steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal and shall conform to the applicable provisions of AWS D1.5M/D1.5 for all welds. Welding shall be such as to minimize residual stresses, distortion and shrinkage.

d. Welding Technique.

- (1) Filler Metal - The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used or shall be as shown where a specific choice of AWS specification allowable is required. Weld metal toughness shall meet the requirements of AWS D1.5M/D1.5, Tables, 4.1, 4.2, or 12.1 as applicable. The AWS designation of the electrodes to be used shall be included in the schedule of welding procedures. Only low hydrogen electrodes shall be used for manual shielded metal-arc welding regardless of the thickness of the steel. A controlled temperature storage oven shall be used at the job site as prescribed by AWS D1.5M/D1.5, Subsection 12.6 to maintain low moisture of low hydrogen electrodes. Controlled temperature storage ovens shall be powered at all times. FCAW filler metal shall be subjected to the storage and handling requirements defined in AWS D1.5M/D1.5 section 12.6.7.4. Filler metals and processes shall not be combined in the same joint or weld.
- (2) Preheat and Interpass Temperature - Preheating shall be performed as required by the applicable provisions of AWS D1.5M/D1.5 for all welds except that the temperature of the base metal shall be at least 70 degrees F. Preheat for fracture critical welds shall be as defined in Table 12.3 and in accordance with the PQR/WPS. The weldments to be preheated shall be slowly and uniformly heated by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly as required and in accordance with the approved WPS in order to prevent cracking or distortion.

e. Workmanship. Workmanship for welding shall be in accordance with AWS D1.5M/D1.5, Section 3 for all welds and other applicable requirements of these specifications

- (1) Preparation of Base Metal. Prior to welding, inspect surfaces to be welded to assure compliance with the applicable sections of AWS D1.5M/D1.5.
- (2) Tack and Temporary Welds. Tack and temporary welds required for fabrication and erection shall be made in accordance with AWS D1.5M/D1.5 under the controlled conditions prescribed herein for permanent work. Tack welds that are to be incorporated into the permanent work shall be subject to the same quality requirements as the permanent welds. Such tack welds shall be cleaned and fused thoroughly with the permanent welds. Multiple-pass tack welds shall have cascaded ends. Defective tack welds shall be removed before permanent welding. All welds shall be made using low-hydrogen welding electrodes and by welders qualified for permanent work as specified elsewhere in these specifications. Preheat shall be as required by AWS D1.5M/D1.5 for permanent tack welds except that the minimum temperature shall be 70 degrees F in any case, regardless of electrode used. All tack welds which will be incorporated into the final weldment shall be a maximum of 1/8 inch with a minimum length of 1 inch long spaced at a maximum of 6 inch on center. In making temporary welds, arc strikes shall not be struck in other than weld locations. Each temporary weld shall be removed as required by

AWS D1.5M/D1.5, Subsection 3.3.8. All arc strikes struck outside the weld zone shall be ground out, filled, and inspected in accordance with AWS D1.5M/D1.5.

- (3) Weld Access Holes. Weld access holes shall be provided as shown on the shop drawings. If the oversite of intersecting out-of-plane welds is encountered, the fabricator shall notify the Contracting Officer for the approval of weld access hole additions in such locations. Payment for the addition of weld access holes not shown on plans will be the Contractor's responsibility.
- (4) Weld Backing Removal. Unless otherwise indicated, all steel weld backing material shall be removed from welded joints prior to testing. All weld backing material that cannot be removed shall be identified on the shop drawings.
- (5) Weld Backing Material Other Than Steel. All weld backing material, other than steel, shall be qualified by testing and shall be included in submitted PQR/WPS. Variation from approved weld backing material will not be permitted and will require the development and testing a new weld procedure which addresses the change in backing material.

#### 2.1.5 Bolted Connections

All high strength connections shall be tightened to a tension not less than that given in RCSC Specifications for Structural Joints Using for A325 Bolts. Tightening shall be done by turn-of-nut, direct tension indicator, calibrated wrench, or alternative design bolt methods.

All other connections shall be tightened to the snug-tight condition. The snug-tight condition is defined as the tightness attained by either a few impacts of an impact wrench or the full effort of a worker with an ordinary spud wrench that brings the plies into firm contact. Perform snugging in a systematic manner starting at the most rigid part of the joint and working to the outside of the connection or the free edges. Use thin metal feeler gages, such as a machinists 6 inch metal rule, to ensure that gaps do not exist between the steel at the bolt holes. Install all bolts in a connection to a snug tight condition prior to pretensioning. Perform pretensioning in the same order as snug-tightening.

- a. Bolts, Nuts, and Washers. Provide bolts, nuts and washers of the type specified or indicated. All nuts to be used with high strength bolts shall be ASTM A 563. All nuts shall be equipped with washers. Where the use of high strength bolts is specified or indicated the materials, workmanship and installation shall conform to the applicable provisions of ASTM A 325 and RCSC Specifications for Structural Joints Using ASTM A 325. Washers to be used with high strength bolts shall conform to ASTM F 436.
- b. Bolt Holes. Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.
  - (1) Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger than the diameter of the bolt.
  - (2) Holes for high strength fitted bolts shall be match-reamed or drilled. Remove burrs resulting from reaming. The threads of

bolts shall be entirely outside of the holes. The body diameter of holes and bolts shall have tolerances as specified on the drawings.

- (3) The provisions of AWS D1.5M/D1.5 Section 3.7.7 allowing missdrilled holes do not apply. All missdrilled holes shall be repaired as directed by the Engineer. Repair of mislocated or missdrilled holes shall be submitted for Government approval.

#### 2.1.6 Miscellaneous Provisions

- a. Weldments. Portions of the structure include thick weldments where locked in thermal stresses may make final dimensions unstable. The Contractor is required to sequence the work and thermally stress relieve subassemblies of thick weldments such that final machining achieves stable specified dimensions and tolerances.
- b. Drain Holes. Locate drain holes as shown on the drawings, unless otherwise noted. Drain holes shall be drilled. Flame cutting of holes will not be permitted.
- c. Seal Welds. Seal welds are required to maintain water tightness. All seal welds shall be shown and made as indicated on the shop drawings. Seal welds, when called for on the drawings, shall be made the minimum size fillet weld as required in AWS D1.5M/D1.5. In addition, seal welds may require weld wrapping around reentrant corners that is specifically prohibited in AWS D1.5M/D1.5. All seal welds on fracture critical members shall be subjected to the minimum preheat requirements of AWS D1.5M/D1.5 Table 12.3 as applicable. All seal welds shall be subjected to the same testing requirements required for a fillet weld made to any fracture critical member according to AWS D1.5M/D1.5 Chapter 12.

#### 2.1.7 Shop Assembly

Perform fabrication and assembly in an indoor, climate controlled shop. Each item shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. All shop testing for assembly shall be witnessed by the Government Representative. Errors or defects disclosed shall be immediately remedied without cost to the Government.

#### 2.1.8 Seals

Each structure shall be provided with bulb seals as shown on the drawings. The surfaces of finished splices shall be smooth and free of irregularities. Bolt holes in the rubber seals shall be match-drilled with the seal support and clamping bars, as applicable; to insure proper fit and spacing between holes of the completed seal assembly. Seal support and clamping bars shall conform to the configurations shown on the drawings and shall be machine finished. The seals and blocks shall be installed after painting has been completed.

#### 2.1.9 Machine Work

Machine Work Tolerances, allowances and gauges for metal fits between plain, non-threaded, cylindrical parts shall conform to ASME B4.1 for the class of fit shown or required unless otherwise shown on approved detail drawings. Where fits are not shown, they will be suitable as approved.

Tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock will be allowed on placing pads to ensure true surfaces of solid material. Provide finished contact or bearing surfaces true and exact to secure full contact. Polish journal surfaces and finish all surfaces with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be accurately machined and all like parts be interchangeable except that parts assembled together for drilling or reaming of holes or machining will not be required to be interchangeable with like parts. Accurately locate all drilled hole bolts.

#### 2.1.9.1 Finished Surfaces

Provide surface finishes, indicate or specified, in accordance with ASME B46.1. Values of required roughness heights are arithmetical average deviations expressed in microinches. These values are maximum. Lesser degrees will be satisfactory unless otherwise indicated. Compliance with surface requirements shall be determined by sense of feel and visual inspection of the work compared to Roughness Comparison Specimens in accordance with the provisions of ASME B46.1. Values of roughness width and waviness height shall be consistent with the general type of finish specified by roughness height. Where the finish is not indicated or specified use that which is most suitable for the particular surface, provide class of fit is required and be indicated on the detail drawings by a symbol which conforms to ASME B46.1 when machine finishing is provided. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable for the intended use will be cause for rejection.

#### 2.1.9.2 Unfinished Surfaces

Lay out all work to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces chip and grind smooth or machine to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and be chipped or ground free of all projections and rough spots. Fill in depressions or holes not affecting the strength or usefulness of the parts in an approved manner.

### 2.2 CERTIFIED TEST REPORTS

#### 2.2.1 General

Have required material tests and analyses performed and certified by an approved laboratory, at the Contractor's expense, to demonstrate that materials are in conformity with the specifications. Tests, inspections, and verifications shall conform to the requirements of the particular sections of these specifications for the respective items of work unless otherwise specified or authorized. Tests shall be conducted in the presence of the Contracting Officer. Furnish specimens and samples for additional independent tests and analyses upon request by the Contracting Officer.

#### 2.2.2 Nondestructive Testing

When doubt exists as to the soundness of any material part, such part may be subjected to any form of nondestructive testing determined by the Contracting Officer. This may include ultrasonic, magnetic particle, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be

borne by the Government. Any defects will be cause for rejection and rejected parts shall be replaced and retested by the same test method that located the defect at the Contractor's expense.

### 2.2.3 Inspection of Structural Steel Welding

Maintain an approved inspection system and perform required inspections. Welding shall be subject to inspection to determine conformance with the requirements of AWS D1.5M/D1.5 and the approved welding procedures and provisions stated in other sections of these specifications. All completed welds shall be cleaned and carefully visually examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure compliance with the requirements of AWS D1.5M/D1.5, subsection 6.26 and the additional requirements of chapter 12 for the Fracture Control Plan. In addition, the Government may choose to hire a third party inspector to perform verification of this work. The Government's third party inspection will occur at various times throughout the duration of fabrication. The Contractor will be advised that third party inspection shall be coordinated with the GQAR and the Contractor for all verification inspections selected by the Government.

- a. Visual Examination. Prior to any welding, a certified weld inspector (CWI) supplied by the Contractor shall visually inspect and document on the weld tracking log the preparation of material for welding at each weld or joint in order to assure compliance with AWS D1.5M/D1.5 and approved WPS. The CWI shall also perform VT inspection on all completed welds throughout the welding process to assure compliance with AWS D1.5M/D1.5 and approved WPS. All completed welds shall be cleaned free of oxide, flux, scale, paint spatter, or other foreign matter before inspection.
- b. Nondestructive Examination. The nondestructive examination of welds shall be performed as specified or described on the drawings or as listed in the following paragraphs.
  - (1) Testing Agency. The nondestructive examination of welds and the evaluation of examination tests as to the acceptability of the welds shall be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. In either case written approval of the examination procedures is required and the examination tests shall be made in the presence of the Contracting Officer. The evaluation of examination tests shall be subject to the approval of, and all records shall become the property of, the Government. Certified Weld Inspectors (CWI) shall be qualified and certified in accordance with the provisions of AWS QC1 and shall be familiar with AWS D1.5M/D1.5 fracture critical member inspection as required in AWS D1.5M/D1.5 Section 12.16. The laboratory and all personnel performing nondestructive testing shall be qualified as specified. Only individuals qualified for NDT Level II or Level III may perform nondestructive testing. The Level III NDT inspector who supervises all NDT shall possess a currently valid American Society for Nondestructive Testing (ASNT) Level III certificate for each of the processes for which they are qualified. Copies of the certifications, including the ASNT certificate of Level III NDT Technician that certified the Level II Technicians shall be included in the submittals.



- (2) Examination Procedure and Extent. All nondestructive testing shall comply with AWS D1.5M/D1.5, Section 6 or section 12, as applicable. Testing shall be required as defined in the following paragraph.
- (3) Acceptability of Welds. Welds will be unacceptable if shown to have defects prohibited by AWS D1.5M/D1.5.
- (4) Examination Procedures. Examination procedures shall conform to the following requirements:
- (5) Ultrasonic Testing (UT) - Ultrasonic testing of welds shall conform to the provisions of AWS D1.5M/D1.5. The ultrasonic equipment shall be capable of making a permanent record of the test indications. A record shall be made of each weld tested.
- (6) Radiographic Testing (RT) - Making, evaluating and reporting radiographic testing of welds shall conform to the applicable requirements of AWS D1.5M/D1.5.
- (7) Magnetic Particle Inspection (MT) - Magnetic particle inspection of welds shall conform to the provisions of ASTM E 709 and AWS D1.5M/D1.5, Section 6 and Subsection 12.16 where applicable. Requirements of AWS D1.5M/D1.5 section 6.7.2.3 shall not apply to these specifications, such that secondary members shall be subjected to MT sampling as required. MT by the prod method is prohibited.
- (8) Dye Penetrant Inspection (PT) - Dye penetrant inspection (PT) of welds shall conform to the applicable provisions of ASTM E 165.

#### 2.2.4 Welds to be Subject to Nondestructive Examination

- a. Structural Steel Non-Fracture Critical Members - Full Penetration Welds. Welds shall be inspected in conformance with AWS D1.5M/D1.5, Section 6.7. Testing shall include a representative sample of welds and weld types from all welders and each of the processes each welder used. Testing shall be spread throughout the project. 100 per cent of all Full Penetration welds on non-fracture critical members shall be tested.
- b. Structural Steel Non-Fracture Critical Member Fillet Welds and Partial Penetration Welds. A minimum of 50 per cent of all fillet welds and partial penetration welds shall be randomly selected for examination by magnetic particle and or dye penetrant testing procedures described previously. The random testing shall include a representative sample of welds and weld types from all welders and each of the processes each welder used. The random testing shall be spread throughout the project. A schedule for implementing the random testing shall be developed and submitted for approval prior to fabrication.
- c. Structural Steel Fracture Critical Member Welds. All welds on FCM shall be tested in accordance with AWS D1.5M/D1.5, Subsection 12.16. 100 per cent of all fracture critical full-penetration welds on fracture critical members shall be subjected to ultrasonic testing. Butt joints in tension shall be inspected by both RT and UT. The testing shall be done as early in the project as possible to ensure the quality of the procedure and process. Weld backing shall be removed from all fracture critical welds prior to all NDE unless the weld

backing member is permanent. The UT report for all butt welds shall include non-rejectable indications with defect severity ratings within 5 db of being rejectable and shall be fully recorded as to indication, rating, size, and location. In accordance with AWS D1.5M/D1.5 Section 12.16.5.3, all discontinuities found by UT must be recorded.

#### 2.2.5 Test Coupons

The Government reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved by nondestructive examination. Should tests of any two coupons, cut from the work of any welder, show strengths less than that specified for the base metal it will be considered evidence of negligence or incompetence and such welder shall be removed from the work. When coupons are removed from any part of a structure, the members cut shall be repaired in an appropriate manner with joints of the proper type to develop the full strength of the members. Repaired joints shall be heated or peened as approved or directed to relieve residual stress. The expense for removing and testing coupons, repairing cut members and the nondestructive examination of repairs will be borne by the Government. If the coupons fail testing, repair costs as well as sampling costs, will be borne by the Contractor.

#### 2.2.6 Supplemental Examination

When the soundness of any weld is suspected of being deficient, due to faulty welding or stresses that might occur during shipment or erection, the Government reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Government. If welds are found to be defective, the Contractor shall repair the defective work and bear the cost of the inspection.

#### 2.2.7 Structural Steel Welding Repairs

Defective welds in the structural steel should be defined as critical repairs or non-critical repairs and shall be repaired in accordance with AWS D1.5M/D1.5, Subsection 3.7 for non-FCM and section 12 for FCM. Make separate submittals for Welding Repairs - Non-Fracture Critical Members and Welding Repairs - Fracture Critical Members. All weld repairs to fracture critical members shall be considered critical welds in accordance with AWS D1.5M/D1.5 Section 12.17.3 and shall be approved by the Engineer of Record. Approval by the Government shall be obtained for weld repairs to mill defects in the base metal, repair of cracks, or a revised design to compensate for deficiencies. The Contractor may prepare procedures and specifications for the repair of anticipated routine problems and submit them for approval before fabrication begins. Critical weld repairs require a WPS specific to the weld repair. Defective weld metal shall be removed to sound metal by use of air carbon-arc gouging. Oxygen gouging for purposes of weld repair shall not be permitted. The surfaces shall be thoroughly cleaned before welding. Inadequate removal of welds that damages the base metal shall be subject to replacement of the base metal, or compensation for the deficiency in a manner approved by the Contracting Officer. Welds that have been repaired shall be retested by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds, costs of repairs and retesting shall be borne by the Contractor.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Cleaning

All parts to be installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Holes and grooves for lubrication shall be cleaned. Enclosed chambers or passages shall be examined to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for assembling and tightening parts. Non-Structural bolts and screws shall be tightened firmly and uniformly but care shall be taken not to overstress the threads. When a half nut is used for locking a full nut the half nut shall be placed first and followed by the full nut. Threads of all bolts except high strength bolts, nuts and screws shall be lubricated with an approved lubricant before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

#### 3.1.2 Alignment and Setting

Each machinery component or structural unit attached to structurals fabricated according to this specification shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Shims are to remain with the final installation where called for on the drawings. Where parts are press-fit, anti seize compound shall be applied to laying surfaces.

### 3.2 PROTECTION OF FINISHED WORK

Machined surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means. Finished surfaces of ferrous metals to be in bolted contact shall be washed with an approved rust inhibitor and coated with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods. Finished surfaces of metals shall be painted as specified in specification SECTION 09964: PAINTING - HYDRAULIC STRUCTURES.

### 3.3 PAINTING

All exposed surfaces of the structure shall be painted as specified in Section 09964: PAINTING - HYDRAULIC STRUCTURES. All edges of plate shall be ground prior to coating. Grinding plate edges shall be accomplished before paint preparation in order to remove hardness as a result of flame cutting. All square edges and holes other than bolt holes shall be broken and ground to a 1/16 inch radius prior to painting.

-- End of Section --

## SECTION 09964

## PAINTING: HYDRAULIC STRUCTURES

## 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 within the text by the basic designation only.

## AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE Z87.1 (2003) Standard for Occupational and Educational Eye and Face Protection

## ASTM INTERNATIONAL (ASTM)

ASTM D 7091 (2005) Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nondestructive Coatings Applied to Non-Ferrous Metals

## INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ISEA Z358.1 (2004) Emergency Eyewash and Shower Equipment

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

## NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 98-119 (1998; 4th Ed) Supplement 2 to NIOSH Manual of Analytical Methods

## THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 6 (2004) Guide for Containing Debris Generated During Paint Removal Operations

SSPC PS 12.01 (2002; E 2004) One Coat Zinc-Rich Painting System

SSPC PS 13.01 (1982; E 2004) Epoxy Polyamide Painting System

SSPC Paint 20 (2002; E 2004) Paint Specification No. 20 Zinc-Rich Coating Type I Inorganic and Type II Organic

SSPC Paint 22	(1982; E 2004) Paint Specification No. 22 Epoxy-Polyamide Paints (Primer, Intermediate, and Topcoat)
SSPC QP 1	(1998; E 2004) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC QP 2	(2000; E 2004; E 2007) Standard Procedure for the Qualification of Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual
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## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.20	Access to Employee Exposure and Medical Records
29 CFR 1910.94	Ventilation
29 CFR 1926.62	Lead
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 262.22	Number of Copies
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
49 CFR 171	General Information, Regulations, and Definitions

## 1.2 SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS

Perform work in accordance with all applicable health, safety, and environmental requirements as well as EM 385-1-1. Submit matters of Interpretation of Safety, Health, and Environmental Requirements to the Contracting Officer for resolution before starting work. Where the

regulations conflict, the most stringent requirements shall apply. This paragraph supplements the health, safety, and environmental requirements of EM 385-1-1.

#### 1.2.1 Safety

Submit a Safety Plan and a Ventilation Assessment Plan. Comply with all applicable safety standards.

##### 1.2.1.1 Abrasive Blasting

For abrasive blasting comply with the requirements in Section 06.H of EM 385-1-1. In addition to the requirements in Section 20 of EM 385-1-1, use hoses and hose connections of a type to prevent shock from static electricity. Hose lengths shall be joined together by approved couplings of a material and type designed to prevent erosion and weakening of the couplings. The couplings and nozzle attachments shall fit on the outside of the hose and designed to prevent accidental disengagement.

##### 1.2.1.2 Workers Other Than Blasters

Protect workers, other than blasting operators working in close proximity to abrasive blasting operations, by utilizing MSHA/NIOSH-approved half-face or full-face air purifying respirators equipped with high-efficiency particulate air (HEPA) filters, eye protection meeting or exceeding ASSE/SAFE Z87.1 and hearing protectors (ear plugs and/or ear muffs) providing a noise reduction rating of at least 20 dBA or as needed to provide adequate protection. Personal protective equipment shall be provided where required by 29 CFR 1910.146 and in accordance with 29 CFR 1910, Subpart I.

##### 1.2.1.3 Cleaning Before and After Abrasive Blasting

Cleaning with compressed air shall be in accordance with Section 20.B.5 of EM 385-1-1, and personnel shall be protected as specified in 29 CFR 1910.134. When cleaning with solvents, provide ventilation where required by 29 CFR 1910.146, or where the concentration of solvent vapors exceeds 10 percent of the Lower Explosive Limit (LEL). Ventilation shall be in accordance with 29 CFR 1910.94, paragraph (c)(5).

##### 1.2.1.4 Paint Mixing

Local exhaust ventilation shall be provided in the area where coatings are mixed. This ventilation system shall be capable of providing at least 100-linear fpm of capture velocity in the mixing zone. Exposure of skin and eyes shall be avoided by wearing appropriate chemically resistant gloves, apron, safety goggles, and face shields meeting or exceeding the requirements of ASSE/SAFE Z87.1. A combination unit, comprised of an eyewash and deluge shower, within close proximity to the mixing operation shall be provided in accordance with ISEA Z358.1, paragraph (9). Individuals who have a history of, or develop a sensitivity to epoxy or polyurethane resin systems, shall not conduct work tasks or otherwise be exposed to such chemicals.

##### 1.2.1.5 Confined Spaces

When using solvent-based paint in confined spaces, prepare a Confined Spaces Plan. Provide ventilation to exchange air in the space at a minimum rate of 5,000 cubic feet per minute per spray gun in operation. It may be

necessary to install both a mechanical supply and exhaust ventilation system to effect adequate air changes within the confined space. Locate and affix all air-moving devices to an opening of the confined space in a manner assuring that the airflow is not restricted or short circuited and is supplied in the proper direction. Means of egress shall not be blocked. Continue ventilation after completion of painting and through the drying phase of the operation. If the ventilation system fails or the concentration of volatiles exceeds 10 percent of the LEL (except in the zone immediately adjacent to the spray nozzle), stop painting and evacuate spaces until adequate ventilation is provided. Provide an audible alarm that signals system failure as an integral part of the ventilation system. The effectiveness of the ventilation shall be checked by using ventilation smoke tubes and making frequent oxygen and combustible gas readings during painting operations. Exhaust ducts shall discharge clear of the working areas and away from possible sources of ignition.

#### 1.2.1.6 Paint Spraying

Submit a Respiratory Protection Plan. During all spray painting operations, spray painters shall use approved SCBA or SAR (air line) respirators, unless valid air sampling has demonstrated contaminant levels to be consistently within concentrations that are compatible with air-purifying respirator Assigned Protection Factor (APF). Persons with facial hair that interferes with the sealing surface of the facepiece to face seal or interferes with respirator valve function shall not be allowed to perform work requiring respiratory protection. Air-purifying chemical cartridge/canister half- or full-facepiece respirators that have a particulate prefilter and are suitable for the specific type(s) of gas/vapor and particulate contaminant(s) may be used for nonconfined space painting, mixing, and cleaning (using solvents). These respirators may be used provided the measured or anticipated concentration of the contaminant(s) in the breathing zone of the exposed worker does not exceed the APF for the respirator and the gas/vapor has good warning properties or the respirator assembly is equipped with a NIOSH-approved end of service life indicator for the gas(es)/vapor anticipated or encountered. Where paint contains toxic elements that may become airborne during painting in nonconfined spaces, air-purifying half- and full-facepiece respirators or powered air-purifying respirators equipped with appropriate gas vapor cartridges, in combination with a high-efficiency filter, or an appropriate canister incorporating a high-efficiency filter, shall be used.

#### 1.2.1.7 Explosion Proof Equipment

Electrical wiring, lights, and other equipment located in the paint spraying area shall be of the explosion proof type designed for operation in Class I, Division 1, Group D, hazardous locations as required by the NFPA 70. Electrical wiring, motors, and other equipment, outside of but within 20 feet of any spraying area, shall not spark and shall conform to the provisions for Class I, Division 2, Group D, hazardous locations. Electric motors used to drive exhaust fans shall not be placed inside spraying areas or ducts. Fan blades and portable air ducts shall be constructed of nonferrous materials. Motors and associated control equipment shall be properly maintained and grounded. The metallic parts of air-moving devices, spray guns, connecting tubing, and duct work shall be electrically bonded and the bonded assembly shall be grounded.

#### 1.2.1.8 Further Precautions

A. Workers shall wear nonsparking safety shoes.

- B. Place and ground solvent drums, taken into the spraying area, on nonferrous surfaces. Maintain metallic bonding between containers and drums when materials are being transferred.
- C. Inspect insulation on all power and lighting cables to ensure that the insulation is in excellent working condition and is free of all cracks and worn spots. Cables shall be further inspected to ensure that no connections are within 50 feet of the operation, that lines are not overloaded, and that they are suspended with sufficient slack to prevent undue stress or chafing.

#### 1.2.1.9 Ignition Sources

Ignition sources, to include lighted cigarettes, cigars, pipes, matches, or cigarette lighters shall be prohibited in area of solvent cleaning, paint storage, paint mixing, or paint application.

#### 1.2.2 Health

Prepare and submit a Medical Surveillance Plan.

##### 1.2.2.1 Air Monitoring

Prepare and submit an Air Monitoring Test Plan. Perform air sampling and testing as needed to assure that workers are not exposed to contaminants above the permissible exposure limit. In addition, provide the Contracting Officer with a copy of the Air Monitoring Test Report from the laboratory within five working days of the sampling date, and provide results from direct-reading instrumentation on the same day the samples are collected. Prepare and submit an Airborne Sampling Plan as specified in the "SUBMITTALS" paragraph.

##### 1.2.2.2 Medical Status

Prior to the start of work, and annually thereafter, prepare a Medical Status Report. Medically evaluate all Contractor employees working with or around paint systems, thinners, blast media, those required to wear respiratory protective equipment, and those who will be exposed to high noise levels for the particular type of exposure they may encounter. Maintain medical records as required by 29 CFR 1910.20. The evaluation shall include:

- a. Audiometric testing and evaluation of employees who will work in a noise environment with a time weighted average greater than or equal to 90 dBA.
- b. Vision screening (employees who use full-facepiece respirators shall not wear contact lenses).
- c. Medical evaluation shall include, but shall not be limited to, the following:
  - (1) Medical history including, but not limited to, alcohol use, with emphasis on liver, kidney, and pulmonary systems, and sensitivity to chemicals to be used on the job.
  - (2) General physical examination with emphasis on liver, kidney, and pulmonary system.



(3) Determination of the employee's physical and psychological ability to wear respiratory protective equipment and to perform job-related tasks.

(4) Determination of baseline values of biological indices for later comparison to changes associated with exposure to paint systems and thinners or blast media, which include: liver function tests to include SGOT, SGPT, GGPT, alkaline phosphates, bilirubin, complete urinalysis, EKG (employees over age 40), blood urea nitrogen (bun), serum creatinine, pulmonary function test, FVC, and FEV, chest x-ray (if medically indicated), blood lead and ZPP (for individuals where it is known there will be an exposure to materials containing lead), other criteria that may be deemed necessary by the Contractor's physician, and Physician's statements for individual employees that medical status would permit specific task performance.

(5) For lead-based paint removal, the medical requirements of 29 CFR 1926.62 shall also be included. Prepare and submit a Lead-Based Paint Worker Protection Plan.

#### 1.2.2.3 Change in Medical Status

Any employee whose medical status has changed negatively due to work related chemical and/or physical agent exposure while working with or around paint systems and thinners, blast media, or other chemicals shall be evaluated by a physician, and obtain a physicians statement as described in paragraph "Medical Status" prior to allowing the employee to return to those work tasks. Provide the Contracting Officer a Change in Medical Status Report detailing any negative changes in employee medical status and the results of the physicians reevaluation statement.

#### 1.2.3 Environmental Protection

Prepare an Environmental Protection Plan to comply with the following environmental protection criteria.

##### 1.2.3.1 Waste Classification, Handling, and Disposal

Prepare and submit a Waste Classification, Handling, and Disposal Plan. The Contractor is responsible for assuring the proper disposal of all hazardous and nonhazardous waste generated during the project. Waste generated from abrasive blasting, lead-containing paints with recyclable steel or iron abrasives shall be disposed of as a hazardous waste or shall be stabilized with proprietary pre-blast additives regardless of the results of 40 CFR 261 App II, Mtd 1311. Where stabilization is preferred, employ a proprietary blast additive, that has been blended with the blast media prior to use. Place hazardous waste in properly labeled, closed containers shielded adequately to prevent dispersion of the waste by wind or water. Any evidence of improper storage shall be cause for immediate shutdown of the project until corrective action is taken. Store nonhazardous waste in closed containers separate from hazardous waste storage areas. All hazardous waste shall be transported by a licensed transporter in accordance with 40 CFR 263 and 49 CFR 171, Subchapter C. All nonhazardous waste shall be transported in accordance with local regulations regarding waste transportation. In addition to the number of copies required by 40 CFR 262.22, one copy of each Waste Manifest will be supplied to the Contracting Officer prior to transportation.

### 1.2.3.2 Containment

Prepare a Containment Plan. Contain debris generated during paint removal operations in accordance with the requirements of SSPC Guide 6, Class 2A or 3A. Where required, verify the containment air pressure by instrument.

### 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.

#### SD-01 Preconstruction Submittals

Interpretation of Safety, Health, and Environmental Requirements; G

This submittal requests Government clarification of safety, health, and environmental requirements. If no clarifications are sought, then the submittal shall so state.

Safety Plan; G

A Safety Plan in accordance with the requirements of Section 01 of EM 385-1-1, including, but not limited to, each of the topic areas listed in Appendix A therein and the specified requirements. Develop each topic in a concise manner to include management and operational aspects.

Confined Spaces Plan; G

Detailed written standard operating procedures for confined spaces in accordance with 29 CFR 1910.146 and EM 385-1-1, Section 6I. The procedures shall include:

a. Certificates of calibration for all testing and monitoring equipment. The certificates of calibration shall include: type of equipment, model number, date of calibration, firm conducting calibration, and signature of individual certifying calibration.

b. Methods of inspection of personal protective equipment prior to use.

c. Work practices and other engineering controls designed to reduce airborne hazardous chemical exposures to a minimum.

d. Specification of the design and installation of ventilation systems which shall provide adequate oxygen content and provide for the dilution of paint solvent vapor, lead, and other toxic particulates within the confined space. In addition, include plans to evaluate the adequacy of air flow patterns.

Respiratory Protection Plan; G

A comprehensive written respiratory protection program in accordance with 29 CFR 1910.134, 29 CFR 1926.62, and Section 05.E of EM 385-1-1.

## Airborne Sampling Plan; G

An Airborne Sampling Plan detailing the NIOSH 98-119, Factory Mutual, or Underwriters Laboratories approved equipment, equipment calibration procedures, sampling methods, sampling to be performed, and analytical procedures to be used based on the type of work to be performed and anticipated toxic contaminants to be generated. Include the name of the accredited laboratory, listed by the American Industrial Hygiene Association (AIHA), to be used to conduct the analysis of any collected air samples.

## Ventilation Assessment Plan; G

A plan to provide ventilation assessment.

## Medical Surveillance Plan; G

A Medical Surveillance Plan and a statement from the examining physician indicating the name of each employee evaluated and any limitations which will preclude the employee from performing the work required. The statement shall include the date of the medical evaluation, the physician's name, signature, and telephone number.

## Lead-Based Paint Worker Protection Plan; G

A Lead-Based Paint Worker Protection Plan in accordance with the requirements of 29 CFR 1926.62, addressing all necessary aspects of worker protection and including activities emitting lead, means to achieve compliance, alternative technologies considered, air monitoring program, implementation schedule, work practice program, administrative controls, multi-Contractor site arrangements, and jobsite inspections.

## Environmental Protection Plan; G

## Waste Manifest; G

An Environmental Protection Plan, incorporating the submittals for Water Quality Plan, Containment Plan, Waste Classification, Handling, and Disposal Plan, Soil Quality Plan, TSP Monitoring Plan, PM-10 Monitoring Plan, and Visible Emissions Monitoring Plan. The submitted plan shall also address all aspects of establishing and demarcating regulated areas, ventilation/containment system performance verification, and reporting of accidental releases.

## Waste Classification, Handling, and Disposal Plan; G

A Waste Classification, Handling, and Disposal Plan in accordance with the requirements of 40 CFR 261 and 40 CFR 262 and paragraph "Waste Classification, Handling, and Disposal."

## Containment Plan; G

A Containment Plan for containing debris generated during paint removal operations, including drawings, load-bearing capacity calculations, and wind load calculations. When the design is such that the spent abrasive is allowed to accumulate in quantities greater than 1,000 pounds, and/or impart a significant wind load

on the structure, the Contractor shall have the drawings approved by a Registered Structural Engineer. The drawings and calculations shall be stamped with the Engineer's seal. Also identify the type and placement of water booms, methods for anchoring the booms, and the procedures for removing debris.

#### SD-03 Product Data

Manufacturer's Product Data Sheet; G

For products that are specified to be applied in accordance with the manufacturer's recommendations, submit the paint manufacturer's product data sheet or other written instructions for those products.

#### SD-04 Samples

Product Samples; G

Special Paint Formulas; G

Samples of all special paint formula, Military, Master Painter Institute, and SSPC paints and samples of solvents or thinners used to reduce the viscosity of the paint. Allow at least 30 days for sampling and testing of samples of paints and thinners. Sampling may be at the jobsite or source of supply. Notify the Contracting Officer when the paint and thinner are available for sampling. Sampling of each batch will be witnessed by the Contracting Officer unless otherwise specified or directed. Submit a 1-quart sample of paint and thinner for each batch proposed for use. The sample shall be labeled to indicate formula or specification number and nomenclature, batch number, batch quantity, color, date made, and applicable project Contract number. Testing will be performed by the Government. Costs for retesting rejected material will be deducted from payments to the Contractor.

#### SD-06 Test Reports

Inspection Reports; G

Records of inspections and operations performed. Submittals shall be made on a daily basis.

Medical Status Report; G

Records of medical tests.

Change in Medical Status Report; G

Medical reports indicating changes in the medical status of workers.

Air Monitoring Test Plan; G

Air Monitoring Test Report; G

Records of monitoring plans and tests performed. Reports shall be submitted as soon as information is available.

#### SD-07 Certificates

Certified EHS Professional; G

Qualifications, certifications, and experience of qualified and competent persons employed to provide preconstruction and onsite environmental, safety, and health services shall be provided. Obtain acceptance of this submission prior to the submission of other required environmental, safety, and health submittal items.

SSPC-QP 1 Certificate; G

A copy of their current SSPC QP 1 certification.

SSPC-QP 2 Certificate; G

Qualified Hazardous Paint Removal Contractor; G

Copy of current SSPC QP 2 and other required certifications.

Coating Thickness Gage Qualification; G

Documentation of manufacturer's certification for all coating thickness gages.

Qualified Paint Applicator; G

Records of qualification tests and third party certification.

#### 1.4 QUALIFICATIONS

Qualifications and experience shall comply with the following.

##### 1.4.1 Certified Environmental, Health, and Safety Professionals

Provide a certificate for each Certified EHS Professional. Utilize a qualified and competent person as defined in Section 01 of EM 385-1-1 to develop the required safety and health submittal and to provide onsite safety and health services during the Contract period. The person shall be a Certified Industrial Hygienist (CIH), an Industrial Hygienist (IH), or a Certified Safety Professional (CSP) with a minimum of 3 years of demonstrated experience in similar related work. The CIH, IH, or CSP may utilize other qualified and competent persons, as defined in EM 385-1-1, to conduct on-site safety and health activities as long as these persons have a minimum of 2 years of demonstrated experience in similar related work and are under the direct supervision of the CIH, IH, or CSP. For lead containing jobsites, the competent and qualified person shall have successfully completed an EPA or state accredited lead-based paint abatement Supervisor course specific to the work to be performed and shall possess current and valid state and/or local Government certification, as required.

##### 1.4.2 Qualified Painting Contractor

The Contractor shall be a certified SSPC-QP 1 Painting Contractor. Submit a copy of the SSPC-QP 1 Certificate.

##### 1.4.3 Qualified Hazardous Paint Removal Contractor

The Contractor shall be certified SSPC-QP 2 Painting Contractor. Provide a copy of the SSPC-QP 2 Certificate.

#### 1.4.4 Qualified Paint Applicator

Documentation of certification shall be submitted for each Qualified Paint Applicator. Prior to the initiation of any work all paint applicators shall be tested and certified as meeting the requirements of the qualified paint applicator. Certification shall be administered by the Government approved independent third party Test Agency. Applicators failing the certification test shall not be permitted to apply any paint on the project.

##### 1.4.4.1 Test Plate

The test plate shall consist of a 6 by 6 feet steel plate with a 3/8-inch minimum thickness. The test plate shall have at least six bolts, three with bolt heads exposed and three with threads exposed, a 12-inch wide flange and a 6-inch diameter pipe each 18 inches long welded perpendicular to the test panel and a 6-inch deep T-beam with sealed ends welded horizontal across the test panel one foot up from the bottom all within the area to be painted on one side. Bolts shall be 1-inch minimum diameter.

##### 1.4.4.2 Certification Test Procedure

Conduct certification testing of paint applicators at the job site in coordination with the Contracting Officer. Supply the fabricated test plates to be used for the tests and provide crane service, rigging, and any other work necessary to provide accessibility for the certification testing and inspection. In preparation, clean and prepare the test plates in accordance with the requirements of the contracted work. Perform abrasive blasting with the blast media to be used in the Contract. The paints to be applied shall be the Contractor supplied materials and shall be those previously tested and approved for use on the Contract. Paints shall be applied as specified in the Contract. The painter being tested shall mix and thin the paints to be used in the test and shall set up and adjust the application equipment for use. Each painter shall apply each of the types of paint comprising the specified system. The test plate shall be painted in a near vertical position.

##### 1.4.4.3 Certification Criteria

Evaluate the paint applicator based on the conformance of the applied paint system to the requirements of the specifications. Deficiencies in the coatings, improper mixing or improper application methods are basis for failure. The Test Agency shall be the sole judge as to the acceptability of each paint applicator's performance.

##### 1.4.5 Coating Thickness Gage Qualification

Submit a Coating Thickness Gage Qualification certificate for each gage. Magnetic flux thickness gages as described in ASTM D 7091 shall be used to make all coating thickness measurements on ferrous metal substrates. Eddy current thickness gages as described in ASTM D 7091 shall be used to measure coating thickness on all nonferrous metal substrates. Gages shall have an accuracy of plus/minus 3 percent or better. Gages to be used on the job shall be certified by the manufacturer as meeting these requirements.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Process and package paints to ensure that within a period of one year from

date of manufacture, they will not gel, liver, or thicken deleteriously, or form gas in the closed container. Paints, unless otherwise specified or permitted, shall be packaged in standard containers not larger than 5 gallons, with removable friction or lug-type covers. Containers for vinyl-type paints shall be lined with a coating resistant to solvents in the formulations and capable of effectively isolating the paint from contact with the metal container. Each container of paint or separately packaged component thereof shall be labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name, and formula or specification number of the paint together with special labeling instructions, when specified. Paint shall be delivered to the job in unbroken containers. Paints that can be harmed by exposure to cold weather shall be stored in ventilated, heated shelters. All paints shall be stored under cover from the elements and in locations free from sparks and flames.

#### 1.6 AMBIENT CONDITIONS

Paint shall be applied only to surfaces that are above the dew point temperature and that are completely free of moisture as determined by sight and touch. Paint shall not be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, the temperature of the surfaces to be painted and of air in contact therewith shall be not less than 45 degrees F during paint application nor shall paint be applied if the surfaces can be expected to drop to 32 degrees F or lower before the film has dried to a reasonably firm condition. During periods of inclement weather, painting may be continued by enclosing the surfaces and applying artificial heat, provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint shall not be applied to surfaces heated by direct sunlight or other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

### PART 2 PRODUCTS

Product Samples of each batch of thinner, solvent, and paint shall be submitted to the Government for testing. Submit Manufacturer's Product Data Sheet for each type of paint used.

#### 2.1 SPECIAL PAINT FORMULAS

Special paints shall have the composition as indicated in the formulas listed herein. Where so specified, certain components of a paint formulation shall be packaged in separate containers for mixing on the job. If not specified or otherwise prescribed, the color shall be that naturally obtained from the required pigmentation.

#### 2.2 PAINT FORMULATIONS

Special paint formulas shall comply with the following:

##### 2.2.1 Epoxy-Polyamide

A. System: SSPC PS 13.01.

B. Paints: SSPC Paint 22, Primer, Intermediate and Top Coats.

### 2.2.2 Zinc Rich Primer

A. System: SSPC PS 12.01.

B. Paints: SSPC Paint 20, MIL-P-24441/19 Formula 159, Type II.

## PART 3 EXECUTION

### 3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED

#### 3.1.1 General Requirements

Clean surfaces to be painted before applying paint or surface treatments. Remove deposits of grease or oil in accordance with SSPC SP 1, prior to mechanical cleaning. Solvent cleaning shall be accomplished with mineral spirits or other low toxicity solvents having a flash point above 100 degrees F. Use clean cloths and clean fluids to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Protect items not to be prepared or coated from damage by the surface preparation methods. Machinery shall be protected against entry of blast abrasive and dust into working parts. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces, and surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations. Welding of, or in the vicinity of, previously painted surfaces shall be conducted in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum; paint damaged by welding operations shall be restored to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed shall be painted before they become inaccessible.

#### 3.1.2 Blast Cleaning

SSPC SP 10/NACE No. 2. After solvent cleaning, complete surface preparation by near-white blast cleaning. Remove residual dust from blasted surface by blowing with dry, oil-free air, vacuuming, or sweeping. Provide surface profile of at least 1 1/2-mil thickness.

### 3.2 PAINT APPLICATION

#### 3.2.1 General

The finished coating shall be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture, and gloss. Application of initial or subsequent coatings shall not commence until the Contracting Officer has verified that atmospheric conditions and the surfaces to be coated are satisfactory. Each paint coat shall be applied in a manner that will produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities shall receive special attention to ensure that they receive an adequate thickness of paint. Spray equipment shall be equipped with traps and separators and where appropriate, mechanical agitators, pressure gauges, pressure regulators, and screens or filters. Air caps, nozzles, and needles shall be as recommended by the spray equipment manufacturer for the material being applied. Airless-type spray equipment may be used only on broad, flat, or otherwise simply configured surfaces, except that it may be employed for general painting if the spray gun is equipped with dual or adjustable tips of proper types and orifice sizes. Airless-type equipment



shall not be used for the application of vinyl paints.

### 3.2.2 Proportioning of Epoxy-Polyamide System

Epoxy-Polyamide coatings consist of a two-component system that includes a pigmented polyamide resin, Component A and an epoxy resin, Component B. Mix both components in a ratio of 1 to 1 by volume. Do not thin coatings when doing so will result in total volatile organic compounds exceeding limits enacted by local air pollution control district. When thinning is allowed and is necessary, such as during cold temperature application or to improve application characteristics, add up to one pint of ethylene glycol monoethyl (EGM) ether of each 4 gallons of the coating. Paint product used shall not contain OSHA-recognized carcinogenic materials.

### 3.2.3 Mixing

Power stir components to a smooth, uniform consistency. Stir coating periodically during induction period. Follow coating manufacturer's requirements for induction time and pot life of mixed batches.

### 3.2.4 Time Between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting shall be primed as soon as practicable after such preparation has been completed but, in any event, prior to any deterioration of the prepared surface. Time between coats shall not exceed 72 hours unless otherwise specified by manufacturer's recommendations.

### 3.2.5 Method of Paint Application

Unless otherwise specified, paint shall be applied by brush, roller, or spray to metal surfaces. Special attention shall be directed toward ensuring adequate coverage of edges, corners, crevices, pits, rivets, bolts, welds, and similar surface irregularities. Other methods of application to metal surfaces shall be subject to the specific approval of the Contracting Officer.

### 3.2.6 Coverage and Film Thickness

Film thickness or spreading rates shall be as specified hereinafter. Where no spreading rate is specified, the paint shall be applied at a rate consistent with the manufacturer's written instructions. In any event, the combined coats of a specified paint system shall completely hide base surface and the finish coats shall completely hide undercoats of dissimilar color.

#### 3.2.6.1 Measurement on Ferrous Metal

Where dry film thickness requirements are specified for coatings on ferrous surfaces, measurements shall be made with a gage qualified in accordance with paragraph "Coating Thickness Gage Qualification." They shall be calibrated and used in accordance with ASTM D 7091. Prior to each use the Base Metal Reading (BMR) shall be established for the gage as specified in the test method. Accuracy of the gage shall be verified using plastic shims as specified by the test method both prior to and following each set of measurements. Frequency of measurements shall be as recommended for field measurements by ASTM D 7091, except that measurements shall be performed on all areas of the structure being coated. Thickness measurements shall be reported as the mean for each spot determination.

### 3.2.7 Progress of Painting Work

Where field painting on any type of surface has commenced, the complete painting operation, including priming and finishing coats, on that portion of the work shall be completed as soon as practicable, without prolonged delays. Sufficient time shall elapse between successive coats to permit them to dry properly for recoating, and this period shall be modified as necessary to suit adverse weather conditions. Paint shall be considered dry for recoating when it feels firm, does not deform or feel sticky under moderate pressure of the finger, and the application of another coat of paint does not cause film irregularities such as lifting or loss of adhesion of the undercoat. All coats of all painted surfaces shall be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease, overspray, or foreign matter by means of airblast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, shall be brush-off blast cleaned and completely repainted as required. Undercoats of high gloss shall, if necessary for establishment of good adhesion, be scuff sanded, solvent wiped, or otherwise treated prior to application of a succeeding coat. Field coats on metal shall be applied after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

### 3.2.8 Contacting Surfaces

When riveted or ordinary bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition, such surfaces will not be required to be painted, but any resulting crevices shall subsequently be filled or sealed with paint. Contacting metal surfaces formed by high-strength bolts in friction-type connections shall not be painted. Where a nonmetal surface is to be in riveted or bolted contact with a metal surface, the contacting surfaces of the metal shall be cleaned and given three coats of the specified primer. Unless otherwise specified, corrosion-resisting metal surfaces, including cladding therewith, shall not be painted.

### 3.2.9 Drying Time Prior to Immersion

Minimum drying periods after final coat prior to immersion shall be: epoxy and moisture cure urethane systems at least 5 days. Minimum drying periods shall be increased twofold if the drying temperature is below 65 degrees F and/or if the immersion exposure involves considerable abrasion.

### 3.2.10 Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures shall be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. All metalwork coated in the shop or field prior to final erection shall be stored out of contact with the ground in a manner and location that will minimize the formation of water-holding pockets; soiling, contamination, and deterioration of the paint film, and damaged areas of paint on such metalwork shall be cleaned and touched up without delay. The first field coat of paint shall be applied within a reasonable period of time after the shop coat and in any

event before weathering of the shop coat becomes extensive.

### 3.2.11 Three-Coat Epoxy-Polyamide System

Apply each coat at a dry film thickness of between 3 mils and 4 mils. Provide total system minimum dry film thickness of 16 mils. Measure using a magnetic gage.

## 3.3 PAINT SYSTEMS APPLICATION

The required paint systems are applied to all new fabrications except as noted. Machined surfaces, stainless steel, and organic materials such as seals and bearings shall not be painted.

### 3.3.1 Fabricated and Assembled Items

Items that have been fabricated and/or assembled into essentially their final form and that are customarily cleaned and painted in accordance with the manufacturer's standard practice will be exempted from equivalent surface preparation and painting requirements described herein, provided that:

- a. Surfaces primed (only) in accordance with such standard practices are compatible with specified field-applied finish coats.
- b. Surfaces that have been primed and finish painted in accordance with the manufacturer's standard practice are of acceptable color and are capable of being satisfactorily touched up in the field.
- c. Items expressly designated herein to be cleaned and painted in a specified manner are not coated in accordance with the manufacturer's standard practice if different from that specified herein.

### 3.3.2 Surface Preparation

The method of surface preparation and pretreatment shown in the tabulation of paint systems is for identification purposes only. Cleaning and pretreatment of surfaces prior to painting shall be accomplished in accordance with detailed requirements previously described.

### 3.3.3 Paint Thickness

Paint shall be spray applied to an average dry film thickness of a minimum of 14 mils for the completed system, and the thickness at any point shall not be less than 12 mils. The specified total film thickness shall be attained in any event, and additional coats needed to attain the specified thickness shall be applied at no additional cost to the Government. Attaining the specified film thickness in fewer than the prescribed number of coats or spray passes will be acceptable provided heavier applications do not cause an increase in pinholes, bubbles, blisters, or voids in the dried film and also provided that no more than 2.0 mils (dry film thickness) per double spray coat nor more than 1.0 mil per single spray pass of nonzinc paint shall be applied at one time.

### 3.3.4 Protection of Nonpainted Items and Cleanup

Walls, equipment, fixtures and all other items in the vicinity of the surfaces being painted shall be maintained free from damage by paint or painting activities. Paint spillage and painting activity damage shall be

promptly repaired.

### 3.4 INSPECTION

Inspect and document all work phases and operations on a daily basis. Submit daily Inspection Reports. As a minimum the daily report shall contain the following:

- a. Inspections performed, including the area of the structure involved and the results of the inspection.
- b. Surface preparation operations performed, including the area of the structure involved, the mode of preparation, the kinds of solvent, abrasive, or power tools employed, and whether Contract requirements were met.
- c. Thinning operations performed, including thinners used, batch numbers, and thinner/paint volume ratios.
- d. Application operations performed, including the area of the structure involved, mode of application employed, ambient temperature, substrate temperature, dew point, relative humidity, type of paint with batch numbers, elapsed time between surface preparation and application, elapsed time for recoat, condition of underlying coat, number of coats applied, and if specified, measured dry film thickness or spreading rate of each new coating.

### 3.5 PAINTING SCHEDULES

Items or surfaces to be coated: all exposed steel surfaces of tainter gates and appurtenances except stainless steel surfaces.

#### SURFACE

PREPARATION	1st COAT	2nd COAT	Finish COAT
SP-10	Organic Zinc Rich Primer 2 mils	Epoxy  6 mils	Epoxy  6 mils

-- End of Section --

## SECTION 11287

## TAINTER GATES AND ANCHORAGES

## PART 1 GENERAL

## 1.1 DESCRIPTION OF WORK

The work in this section includes furnishing and installing tainter gates and appurtenant items, which includes materials, fabrication, delivery, installation, and testing of tainter gates, and appurtenant items including gate leaves, trunnion, anchorages, seal assemblies, guide shoes, lifting brackets, and other items necessary for complete installation.

## 1.2 REFERENCES

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

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.5M/D1.5 (2008; Errata 2009) Bridge Welding Code

## ASTM INTERNATIONAL (ASTM)

ASTM A 193/A 193M (2012) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications

ASTM A 240/A 240M (2010b) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A 276 (2010) Standard Specification for Stainless Steel Bars and Shapes

ASTM A 325 (2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 36/A 36M (2008) Standard Specification for Carbon Structural Steel

ASTM A 514/A 514M (2005) Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

ASTM A 668/A 668M (2004; R 2009) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use

ASTM A 705/A 705M (1995; R 2009) Standard Specification for Age-Hardening Stainless Steel Forgings

ASTM A 709/A 709M	(2009) Standard Specification for Structural Steel for Bridges
ASTM A 992/A 992M	(2011) Standard Specification for Structural Steel Shapes
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 395	(2003; R 2008) Standard Test Methods for Rubber Property - Compression Set
ASTM D 412	(2006ae1e2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 413	(1998; R 2007) Rubber Property - Adhesion to Flexible Substrate
ASTM D 471	(2006; R 2008) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D 572	(2004) Rubber Deterioration by Heat and Oxygen
ASTM F 1554	(2007a) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F 593	(2002; R 2008) Stainless Steel Bolts, Hex Cap Screws, and Studs

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only.

#### SD-02 Shop Drawings

##### Detail Drawings; G

Detail drawings as specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS.

#### SD-03 Product Data

##### Materials

System of identification which shows the disposition of specific lots of approved materials and fabricated items in the work, before completion of the Contract.

Materials orders, materials lists and materials shipping bills as specified in SECTION 05505, STRUCTURAL METAL FABRICATIONS.

##### Welding; G

Schedules of welding procedures for structural steel as

specified in SECTION 05505, STRUCTURAL METAL FABRICATIONS.

#### SD-04 Samples

Materials; G  
Manufactured Units; G  
Fabrications; G

Samples for approval prior to use of the represented materials or items in the work. Samples of standard and shop fabricated items shall be full size and complete as required for installation in the work. Approved samples may be installed in the work provided each sample is clearly identified and its location recorded.

#### SD-06 Test Reports

Tests, Inspections, and Verifications

Certified test reports for material tests with all materials delivered to the site.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Qualification of Welders and Welding Operators

Provide qualification of welders and welding operators conforming to the requirements of SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

#### 1.4.2 Manufactured Units and Fabricated Items

Samples of manufactured units and shop fabricated shall be full-size and complete as required for installation in the work. Approved samples may be installed in the work provided each sample is identified and its location recorded.

#### 1.4.3 Manufacturer Qualification

Tainter gate shall be manufactured by a company with a minimum of 10 years of specialized experience in manufacturing similar gates to meet the requirement of Contract documents.

### 1.5 DELIVERY, STORAGE, AND HANDLING

#### 1.5.1 General

Perform delivery, handling, and storage of materials and fabricated items in conformance with the requirements specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

#### 1.5.2 Rubber Seals

Store rubber seals in a place which permits free circulation of air, maintains a temperature of 70 degrees F or less, and prevents the rubber from being exposed to the direct rays of the sun. Keep rubber seals free of oils, grease, and other materials which would deteriorate the rubber. Rubber seals shall not be distorted during handling.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Provide materials orders, materials lists, and materials shipping bills conforming with the requirements of SECTION 05505, STRUCTURAL METAL FABRICATIONS.

## 2.1.1 Metals

Structural steel, steel forgings, steel castings, stainless steel, bronze, aluminum-bronze, and other metal materials used for fabrication shall conform to the requirements shown on the drawings and specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

## 2.1.1.1 Structural Steel Shapes

ASTM A 709/A 709M, Grade 50. Where specified material is not available, shapes meeting ASTM A 992/A 992M will be acceptable.

## 2.1.1.2 Structural Steel Plates

ASTM A 709/A 709M, Grade 50.

## 2.1.1.3 Stainless Steel Bars and Shapes

Stainless steel bars and shapes shall conform to ASTM A 276, UNS S 30400, Condition A, hot-finished or cold finished, Class C.

## 2.1.1.4 Stainless Steel Plate, Sheet, and Strip

Stainless steel plate, sheet, and strip shall conform to ASTM A 240/A 240M, UNS 30400 and UNS 531603. Plate finish shall be hot-rolled, annealed or heat treated, and blast cleaned or pickled. Sheet and strip finish shall be No. 1.

## 2.1.1.5 Trunnion Assemblies

A. Trunnion hub shall conform to ASTM A 668/A 668M, Class D, Grade X1.

B. Trunnion pin shall conform to ASTM A 705/A 705M, Type 630, UNS 17400, Condition H1150.

C. Trunnion Bushings

Trunnion bushings shall be fabricated from Thermoset composite material with evenly dispersed solid lubricant. Bearing material shall have listed friction coefficient running dry against stainless steel of 0.10, with nominal compressive strength of 40 ksi. Other mechanical stiffness and chemical resistance properties shall be equivalent or superior to Orkot C378.

D. Trunnion Yokes

Trunnion yoke shall be welded steel plate fabrication, ASTM A 709/A 709M, Grade 50.



## E. Trunnion Cover Plate

Trunnion cover plate shall conform to ASTM A 709/A 709M, Grade 50.

## F. Trunnion Anchor Bolts

Trunnion anchor bolt shall conform to ASTM F 1554, Grade D.

## G. Cover Plate Bolts

Cover plate bolts shall conform to ASTM F 593, Alloy Group 5, Type 410, Condition H.

## 2.1.1.6 Guide Shoe Assemblies

## A. Guide Shoe

Guide shoe shall be as shown on the drawing, fabricated from Orkot SL or equivalent material.

## B. Guide Shoe Pedestal

Guide shoe pedestal shall conform to ASTM A 36/A 36M.

## C. Guide Shoe Bolts

Guide shoe bolts shall conform to ASTM A 193/A 193M B8MN.

## 2.1.1.7 Lifting Bracket

A. Lifting bracket shall be welded steel plate fabrication, ASTM A 514/A 514M, Grade F.

B. Lifting bracket bolts shall conform to ASTM F 593, Alloy Group 5, Type 410, Condition H.

## 2.1.2 Rubber Seals

## 2.1.2.1 General

Rubber seals shall be of the mold type only, shall be compounded of natural rubber, synthetic polyisoprene, or a blend of both, and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers. Physical characteristics of the seals shall meet the following requirements:

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
Tensile Strength	2,500 psi (min.)	ASTM D 412
Elongation at Break	450 percent (min.)	ASTM D 412
300-	900 psi (min.)	ASTM D 412
Durometer Hardness (Shore Type A)	60 to 70	ASTM D 2240

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
*Water Absorption	5 percent by weight (max.)	ASTM D 471
Compression Set	30 percent (max.)	ASTM D 395
Tensile Strength (after aging 48 hrs)	80-percent tensile strength (min.)	ASTM D 572

The "Water Absorption" test shall be performed with distilled water. The washed specimen shall be blotted dry with filter paper or other absorbent material and suspended by means of small glass rods in the oven at a temperature of 70 degrees C plus or minus 2 degrees C for 22 hours plus or minus 1/4 hour. The specimen shall be removed, allowed to cool to room temperature in air, and weighed. The weight shall be recorded to the nearest 1 mg as W1 (W1 is defined in ASTM D 471). The immersion temperature shall be 70 degrees C plus or minus 1 degree C and the duration of immersion shall be 166 hours.

## 2.2 MANUFACTURED UNITS

Bolts, nuts, washers, screws and other manufactured units shall conform with the requirements shown on the drawings and specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

### 2.2.1 Bolts, Nuts and Washers

High-strength bolts, nuts, and washers shall conform to ASTM A 325, Type 1, hot-dip galvanized. Other bolts shall be as shown on the drawings.

### 2.2.2 Screws

Screws shall be of the type indicated on the drawings.

## 2.3 FABRICATION

### 2.3.1 Detail Drawings

Detail drawings, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, shall conform to the requirements specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

#### 2.3.1.1 Fabrication Drawings

Show on the fabrication drawings complete details of materials, tolerances, connections, machined surface finishes, and proposed welding sequences which clearly differentiate shop welds and field welds.

#### 2.3.1.2 Shop Assembly Drawings

Provide on the shop assembly drawings details for connecting the adjoining fabricated components in the shop to assure satisfactory field installation.

#### 2.3.1.3 Delivery Drawings

Provide on the delivery drawings descriptions of methods of delivering components to the site, including details for supporting fabricated

components during shipping to prevent distortion or other damages.

#### 2.3.1.4 Field Installation Drawings

Provide on the field installation drawings a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; plan for installation of prestressing assemblies, including proposed stressing sequences and stressing calculations for anchorage assemblies.

#### 2.3.2 Structural Fabrication

Structural fabrication shall conform with the requirements shown on the drawings and specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS. Components shall be shop-fabricated of the materials specified and shown on the drawings. Dimensional tolerances shall be as specified and shown on the drawings. Splices shall occur only where shown on the drawings or approved by the Contracting Officer. Pin holes shall be bored in components after welding, straightening, stress-relieving, and threading operations are completed. Brackets, eye bar sections, and other components requiring straightening shall be straightened by methods which will not damage the material. Bronze bushings shall be press-fitted with supporting components. Bolt connections, lugs, clips, or other pick-up assembly devices shall be provided for components as shown and required for proper assembly and installation. Provisions shall be made for the installation of appurtenances as required.

#### 2.3.3 Welding

Welding shall conform with the requirements AWS D1.5M/D1.5, specified herein, and in SECTION 05505, STRUCTURAL METAL FABRICATIONS. Welds shall be of the type shown on the Contract drawings and approved detail drawings. Radiographic examination is required on the major shop and field welds of the type and location indicated on the drawings. Welds which have been designated to receive radiographic examination and are found to be inaccessible to a radiation source or film, or are otherwise so situated that radiographic examination is not feasible may be examined, with written approval of the Contracting Officer, by dye penetrant, magnetic particle tests, or ultrasonic tests. Components shall be stress-relief heat treated after welding where shown on the drawings. Stress-relieving of components shall be performed prior to the attachment of miscellaneous appurtenances.

#### 2.3.4 Bolted Connections

Bolted connections shall conform with the requirements specified in SECTION 05505, STRUCTURAL METAL FABRICATIONS.

#### 2.3.5 Machine Work

Machine work shall conform with the requirements specified in SECTION 05505, STRUCTURAL METAL FABRICATIONS.

#### 2.3.6 Miscellaneous Provisions

Miscellaneous provisions for fabrication shall conform with the requirements specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

### 2.3.7 Fabrications

#### 2.3.7.1 Gates

Gates shall be of welded fabrication except for bolted appurtenances as shown on the drawings. Structural steel framing members shall be of structural steel conforming to ASTM A 709/A 709M, Grade 50. Skin plate shall conform to ASTM A 709/A 709M, Grade 50. Gates shall be shop-fabricated. Contractor proposed shop-fabrication of gate leaf in separate segments to facilitate handling and shipping must be approved by the Contracting Officer and shall be as shown on approved detail drawings. Such segments shall permit easy field-assembly and shall be as few as practicable to minimize the number of joints to be field-welded. The overall height of gates shall not vary from the nominal dimension by more than 1/4 inch. The surfaces of framing elements which support skin plates shall be in true alignment within 5/16 inch so that skin plates will be in full bearing on all contact surfaces before being welded. The outside faces of skin plates after being welded to framing elements shall not vary from the surface established on the drawings by more than 5/16 inch. Splices in skin plates shall be located only where shown on the drawings. Trunnions shall be an integral part of the gate framing and shall be stress-relieved by heat treatment after welding. The machining of trunnion hubs and bushings shall be performed after welding of the hubs is completed. The classification of fit between trunnion hubs and bushings shall be as shown on the drawings. Gates shall be provided with seal assemblies and other appurtenant items as shown on the drawings.

#### 2.3.7.2 Trunnion Pins

Trunnion pins shall be of stainless steel conforming to ASTM A 705/A 705M, Type 630, UNS S17400, Condition H1150.

#### 2.3.7.3 Trunnion Yokes

Trunnion yokes shall be stress-relieved by heat treatment and machined to the class to fit shown on drawings after fabrication welding is completed.

#### 2.3.7.4 Seal Assemblies

Seal assemblies shall consist of rubber seals, stainless steel clamp bars, and fasteners. Rubber seals shall be continuous over the full length of steel strip. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown on the drawings. All vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45-degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Stainless steel retainer bars shall be field-spliced only where shown on the drawings. Where new seals meet existing seals, facing faces may be glued or vulcanized.

#### 2.3.7.5 Appurtenant Items

Wire rope attachment brackets, side seal plates, sill beams, and other appurtenant items shall conform to the requirements specified and shown on

the drawings. The sealing surfaces of side seal plates and sill beams shall be flush, straight, and free from offsets, warps, twists or other distortions.

#### 2.3.8 Shop Assembly

Shop assembly requirements for tainter gates, anchorage assemblies and appurtenant items shall be as shown on the drawings and specified herein and in Section 05505, STRUCTURAL METAL FABRICATIONS. Gates shall be assembled completely in the shop to assure satisfactory field installation. Adjoining components and appurtenant items shall be fitted and bolted together to facilitate field connections. Assembled components shall be shop-welded in their final positions as much as delivery and field installation conditions permit. Rubber seals shall be fitted and drilled to match the seal skin plate and clamp bar on the gates, match-marked and removed for shipment. Shop assembly and disassembly work shall be performed in the presence of the Contracting Officer unless otherwise waived in writing by the Contracting Officer. The presence of the Contracting Officer during assembly or disassembly will not relieve the Contractor of any responsibility under this Contract.

### 2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

#### 2.4.1 General

Tests, inspections, and verifications for materials shall conform to the requirements specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

#### 2.4.2 Testing of Rubber Seals

The fluoro-carbon film of rubber seals shall be tested for adhesion bond in accordance with ASTM D 413 using either the machine method or the deadweight method. A 1-inch long piece of seal shall be cut from the end of the seal which has been masked and subjected to tension at an angle approximately 90 degrees to the rubber surface. There shall be no separation between the fluoro-carbon film and the rubber when subjected to the following loads:

THICKNESS OF FLUORO-CARBON FILM	MACHINE METHOD AT 2 INCHES PER MINUTE	DEADWEIGHT METHOD
0.030 in.	30 lbs per inch width	30 lbs per inch width

## PART 3 EXECUTION

### 3.1 INSTALLATION

Perform installation conforming with the requirements specified herein and in SECTION 05505, STRUCTURAL METAL FABRICATIONS and SECTION 05500, MISCELLANEOUS METAL FABRICATIONS. Gates and appurtenant items shall be assembled for installation in strict accordance with the Contract drawings, approved installation drawings, and shop match-markings. Bearing surfaces requiring lubrication shall be thoroughly cleaned and lubricated with an approved lubricant before assembly and installation. Components to be field-welded shall be in correct alignment before welding is commenced.

### 3.1.1 Embedded Metals

Perform installation conforming with the requirements specified in SECTION 05500, MISCELLANEOUS METAL FABRICATIONS.

### 3.1.2 Trunnion Yokes

Trunnion yokes shall be installed and adjusted in strict accordance with the procedure shown on the drawings. Special precautions shall be exercised to align the trunnion yokes so that the center lines of trunnion pins at the opposite ends of each gate are concentrically located on the established horizontal line. The eccentricity of the actual centerline of each trunnion pin with respect to the established horizontal line shall not be more than 1/32 inch. The horizontal distance between trunnion yokes shall not vary more than 1/8 inch from the established dimension. Second-pour, high-strength concrete fills shall be placed between the bases of trunnion yokes and concrete corbels.

### 3.1.3 Gates

Gates shall be assembled in the field in strict conformity with shop match markings. Controlling dimensions and alignments shall be checked and corrected as required before starting field welding. Welding shall be done in a manner such that distortion of gates is prevented. Erection bolts, lugs and ties shall be removed after welding is completed. Holes and depressions shall be filled with weld metal and surface projections shall be removed by grinding.

### 3.1.4 Guide Shoes

Guide shoes shall be bolted to the end girder webs at the locations shown on the drawings. Excess material is provided for shoes to accommodate out-of-tolerance between gate and sidewalls up to plus/minus 1/4 inch. Exact dimensions shall be measured on assembled gate and sidewalls. Shoe shall be machined to provide required fit.

### 3.1.5 Trial Operations

Gates shall be trial operated after the complete installation of gates and appurtenant items. Trial operations shall be performed and approved prior to placing the second-pour, high-strength concrete fills around embedded appurtenant items. Hoist lifting cables shall be adjusted before operating the gates. Gates shall move smoothly and without binding or lateral sway when raised and lowered through the complete range of travel. Defects disclosed from trial operations shall be corrected and trial operations repeated by the Contractor at no cost to the Government.

### 3.1.6 Second-Pour, High-Strength Concrete and Concrete Grout Fills

The second-pour, high-strength concrete fills for the embedded items and the space between the base of the concrete grout fills between the yokes of trunnion yokes and the piers shall be as shown on the drawings and as specified in SECTION 03301A, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

### 3.1.7 Painting

Exposed parts of gates and appurtenances, except machined surfaces, stainless steel surfaces, and other specified surfaces shall be painted as

specified in SECTION 09964, PAINTING: HYDRAULIC STRUCTURES.

### 3.1.8 Seal Assemblies

Rubber seal assemblies shall be installed after the embedded metal components have been concreted in place and the gate installation, including painting, completed. Rubber seals shall be fastened securely to clamp bars.

### 3.2 OPERATING MACHINERY

Operating machinery shall conform to SECTION 14601, TAINTER GATE HOISTS.

### 3.3 FIELD TESTS AND INSPECTIONS

#### 3.3.1 Skinplate Watertightness Test

After the gate leaves are installed but prior to painting and mounting of seals, skinplate welds shall be tested for watertightness by applying air pressure with a hose, using a minimum air pressure of 60 psi at the nozzle, to one face of the skinplate with a light coating of soapsuds on the opposite face. Disclosed leaks shall be sealed with light welds.

#### 3.3.2 Acceptance Trial Operation

After completion of the gate installation, the Contracting Officer will examine the gates for final acceptance. The gates will be examined first to determine whether or not the workmanship conforms to the specification requirements. The Contractor will then be required to operate the gates from the fully-opened to the fully-closed position a sufficient number of times to demonstrate to the Contracting Officer's satisfaction that all parts are functioning properly. The workmanship in the fabrication and installation of gates shall be such that the gates in the closed position will form a watertight barrier across the opening. Required repairs or replacements to correct defects, as determined by the Contracting Officer, shall be made at no cost to the Government. The trial operation shall be repeated after defects are corrected. Prior to final acceptance of the gates, provide temporary restraints to prevent unauthorized operation of the gates.

### 3.4 PROTECTION OF FINISHED WORK

Protection of finished work shall conform to the requirements of SECTION 05505, STRUCTURAL METAL FABRICATIONS.

-- End of Section --

## SECTION 11289

## OVERSHOT GATES

## PART 1 GENERAL

## 1.1 DESCRIPTION OF WORK

The work in this section includes furnishing and installing overshot gates and appurtenant items, which includes materials, fabrication, delivery, installation, and testing of overshot gates, and appurtenant items including gate leaves, trunnion, anchorages, seal assemblies, guide shoes, lifting brackets, and other items necessary for complete installation.

## 1.2 REFERENCES

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

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2004) Structural Welding Code - Steel

## ASTM INTERNATIONAL (ASTM)

ASTM A 240/A 240M (2010b) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A 27/A 27M (2003) Steel Castings, Carbon, for General Application

ASTM A 269 (2010) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM A 276 (2010) Standard Specification for Stainless Steel Bars and Shapes

ASTM A 307 (2004) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 312/A 312M (2012) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

ASTM A 325 (2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 36/A 36M (2008) Standard Specification for Carbon Structural Steel

ASTM A 668/A 668M (2004; R 2009) Standard Specification for



Steel Forgings, Carbon and Alloy, for  
General Industrial Use

ASTM B 438 (2008) Standard Specification for Sintered  
Bronze Bearings (Oil Impregnated)

ASTM D 2000 (2008) Standard Classification System for  
Rubber Products in Automotive Applications

ASTM F 594 (2009e1) Standard Specification for  
Stainless Steel Nuts

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-410 (Rev E) Wire Rope and Strand

### 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

Detail Drawings; G

Detail drawings shall be submitted as specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS.

#### SD-03 Product Data

Materials

System of identification which shows the disposition of specific lots of approved materials and fabricated items in the work shall be submitted before completion of the contract.

Welding; G

Schedules of welding procedures for structural steel shall be submitted as specified in Section 05500 MISCELLANEOUS METAL FABRICATIONS.

#### SD-04 Samples

Materials; G  
Manufactured Units; G  
Fabrications; G

Samples shall be submitted and approved prior to use of the represented materials or items in the work. Samples of standard and shop fabricated items shall be full size and complete as required for installation in the work. Approved samples may be installed in the work provided each sample is clearly identified and its location recorded.

#### SD-06 Test Reports

### Tests, Inspections, and Verifications

Certified test reports for material tests shall be submitted with all materials delivered to the site.

#### 1.4 QUALIFICATION OF WELDERS AND WELDING OPERATORS

Qualification of welders and welding operators shall conform to the requirements of Section 05500 MISCELLANEOUS METAL FABRICATIONS.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Delivery, handling, and storage of materials and fabricated items shall conform to the requirements specified in Section 05500 MISCELLANEOUS METAL FABRICATIONS. Materials and equipment delivered to the site by the Contracting Officer shall be unloaded by the Contractor. The Contractor shall verify the condition and quantity of the items delivered by the Contracting Officer and acknowledge receipt and condition thereof in writing. If delivered items are damaged or a shortage is determined, the Contractor shall notify the Contracting Officer of such in writing within 24 hours after delivery.

##### 1.5.1 Rubber Seals

Rubber seals shall be stored in a place which permits free circulation of air, maintains a temperature of 70 degrees F or less, and prevents the rubber from being exposed to the direct rays of the sun. Rubber seals shall be kept free of oils, grease, and other materials which would deteriorate the rubber. Rubber seals shall not be distorted during handling.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Materials orders, materials lists and materials shipping bills shall conform with the requirements of Section 05500 MISCELLANEOUS METAL FABRICATIONS.

##### 2.1.1 Metals

Structural steel, steel forgings, steel castings, stainless steel, bronze, and other metal materials used for fabrication shall conform to the requirements shown and specified herein and in Section 05502 MISCELLANEOUS METAL.

##### 2.1.1.1 Structural Steel

Structural steel shapes shall conform to ASTM A 36/A 36M. Structural steel plates shall conform to ASTM A 36/A 36M.

##### 2.1.1.2 Stainless Steel Bars and Shapes

Stainless steel bars and shapes shall conform to ASTM A 276 .

##### 2.1.1.3 Stainless Steel Plate, Sheet, and Strip

Stainless steel plate, sheet, and strip shall conform to

ASTM A 240/A 240M. Plate finish shall be hot-rolled, annealed or heat-treated, and blast-cleaned or pickled. Sheet and strip finish shall be No. 1.

#### 2.1.2 Rubber Seals

Rubber seals shall be ASTM D 2000 neoprene rubber

### 2.2 MANUFACTURED UNITS

Bolts, nuts, washers, screws and other manufactured units shall conform with the requirements shown and specified herein and in Section 05502 MISCELLANEOUS METAL.

#### 2.2.1 Bolts, Nuts and Washers

High-strength bolts, nuts, and washers shall conform to ASTM A 325. Bolts, nuts, studs, stud bolts and bolting materials other than high-strength shall conform to ASTM A 307. Bolts 1/2 inch and larger shall have hexagon heads. The finished shank of bolts shall be long enough to provide full bearing. Washers for use with bolts shall conform to the requirements specified in the applicable specification for bolts.

#### 2.2.2 Screws

Screws shall be of the type indicated.

#### 2.2.3 Shackles and Turnbuckles

Shackles and turnbuckles shall be of forged steel conforming to ASTM A 668/A 668M, zinc coated. Turnbuckles shall be end-threaded right and left hand and shall be of the size shown.

#### 2.2.4 Screw Jacks

Screw jacks shall have a 2000 lb rated capacity and shall conform to the details shown.

#### 2.2.5 Hoists

Hoists shall be of 4000 lb capacity, link type chain and safety latch hook.

#### 2.2.6 Winches

Winches shall be 4000 lb marine winches.

#### 2.2.7 Sheaves

Sheaves shall be of cast steel conforming to ASTM A 27/A 27M, sized for the wire rope used.

#### 2.2.8 Wire Cable

Wire cable shall conform to FS RR-W-410, wire size, strand seizing as shown.

## 2.3 FABRICATION

### 2.3.1 Detail Drawings

Detail drawings of overshot gate and appurtenant items, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, shall conform to the requirements specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS.

#### 2.3.1.1 Fabrication Drawings

Fabrication drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

#### 2.3.1.2 Shop Assembly Drawings

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

#### 2.3.1.3 Delivery Drawings

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 damages.

#### 2.3.1.4 Field Installation Drawings

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; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; plan for prestressing gate leaf diagonals, which shall include descriptions of connections, riggings, anchorages, and measuring equipment; method for installing hinge anchor plates, including checking and maintaining alignments of the plates during concreting and placement of epoxy filler; and methods for installing other appurtenant items.

### 2.3.2 Structural Fabrication

Structural fabrication shall conform with the requirements shown and specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS. Components shall be shop-fabricated of the materials specified and shown. Dimensional tolerances shall be as specified and shown. Splices shall occur only where shown. Pin holes shall be bored in components after welding, straightening, stress-relieving, and threading operations are completed. Brackets, eye bar sections, and other components requiring straightening shall be straightened by methods which will not damage the material. Bolt connections, lugs, clips, or other pick-up assembly devices shall be provided for components as shown and required for proper assembly and installation.

### 2.3.3 Welding

Welding shall conform with the requirements specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS. Welds shall be in accordance with AWS D1.1/D1.1M of the type shown and approved detail drawings. Welds which have been designated to receive radiographic examination and are

found to be inaccessible to a radiation source or film, or are otherwise so situated that radiographic examination is not feasible may be examined, with written approval, by dye penetrant, magnetic particle tests, or ultrasonic tests. Components shall be stress-relief heat treated after welding where shown. Stress-relieving of components shall be performed prior to the attachment of miscellaneous appurtenances.

#### 2.3.4 Bolted Connections

Bolted connections shall conform with the requirements specified in Section 05500 MISCELLANEOUS METAL FABRICATIONS.

#### 2.3.5 Machine Work

Machine work shall conform with the requirements specified in Section 05500 MISCELLANEOUS METAL FABRICATIONS.

#### 2.3.6 Miscellaneous Provisions

Miscellaneous provisions for fabrication shall conform with the requirements specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS.

#### 2.3.7 Fabrications

Fabrications shall conform to the following requirements.

##### 2.3.7.1 Gate Leaf

Gate leaf dimensions shall be sufficient to span structure width with a total deflection of 1/360 or less of the gate span, or as specified, and provide a water barrier to depth shown on drawings. The gate leaf shall consist of a steel frame joined by welding and covered with a steel sheet face plate. The steel sheet face plate shall be joined to the structural members by welding. Gate arms for attachment of lifting cables shall extend above top of gate leaf.

Gate leaf shall be of welded structural steel fabrication. Gate leaf shall be provided complete with hinge assemblies and seal assemblies, and other appurtenant components as specified and shown. The overall height of gate leaf shall not vary from the nominal dimension or differ from mating gate leaf by more than 1/4 inch. The surfaces of framing elements to which skin plates are to be welded shall not vary from a true plane by more than 1/4 inch. Splices in skin plates shall be located only where shown.

##### 2.3.7.2 Gate Hinge

Gate hinge plates shall be stainless steel conforming to ASTM A 240/A 240M and ASTM A 269, or ASTM A 312/A 312M. The pivot pin shall be stainless steel in accordance with ASTM A 276. The pivot bushings shall be oil filled bronze, SAE AS4841, ASTM B 438.

##### 2.3.7.3 Mounting Angles

The mounting angle shall include stud anchors for embedment in the concrete sill and threaded bolts for bolting the gate hinges to the mounting angle. The studs for attachment of the gate hinge to the mounting angle shall be stainless steel conforming to ASTM A 276. Cap nuts will be ASTM F 594, washers shall be stainless steel.

#### 2.3.7.4 Seal Assembly

Seal assembly shall consist of rubber seals, steel retainer and spacer bars, retractable support, and fasteners. Rubber seals shall be continuous over the full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown. All vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Steel retainer bars shall be field-spliced only where shown and machine-finished after splicing. The retractable support shall be provided complete with hinge and operating winch.

#### 2.3.7.5 Wire Drum Hoist

The hoist shall consist of a hoist base, hoist operator, cable drum and shafts, cables and bearing brackets to operate the overshot gates. The operator shall be adequate to move the gate against a full head of water at the specific gate height. The hoist shall be furnished with a steel drum that is no less than 14 times the lifting cable diameter. Stainless steel cables and clamps shall be furnished for field connection to the drum and to the gate.

#### 2.3.7.6 Manual Hoist

The manual hoist operator shall consist of a self-locking worm/worm wheel configuration gear box, with additional reduction gearing as required, totally enclosed in a cast iron housing. A suitable size handwheel, located approximately 36 inches above the operating surface, shall be provided to produce the necessary output torque to raise the gate when a maximum 40 pound pull is applied to the handwheel rim. The handwheel shall turn counterclockwise to open (lower) the gate and the direction of rotation to open the gate shall be marked on the handwheel.

#### 2.3.7.7 Electrical Hoist

The electrically driven hoist shall consist of a self-locking worm/worm wheel configuration gear box, with additional reduction gearing as required, driven by an electric motor operator with electronic controls and electric power as specified.

#### 2.3.7.8 Miscellaneous Embedded Metals

Wall armor, shear anchors, protection and seal plates and shapes, and other miscellaneous embedded metals shall be of structural steel or corrosion-resisting steel conforming with the details specified herein and shown.

#### 2.3.8 Shop Assembly

Shop assembly requirements for overshot gate and appurtenant items shall be as shown and specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS. Overshot gate and appurtenant items shall be assembled

completely in the shop, unless otherwise approved, to assure satisfactory field installation. Adjoining components shall be fitted and bolted together to facilitate field connections. The matchmarking of unassembled items shall be carefully preserved until the items are assembled. Mating surfaces and machined surfaces shall be covered with a rust preventive until assembly. Assembled components shall be shop-welded in their final positions as much as delivery and field installation conditions will permit. Rubber seals shall be fitted and drilled to match the seal retainers, match-marked, and removed for shipment. Shop assembly and disassembly work shall be performed in the presence of the Contracting Officer unless waived in writing. The presence of the Contracting Officer will not relieve the Contractor of any responsibility under this contract.

## 2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Tests, inspections, and verifications for materials shall conform to the requirements specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall conform with the requirements specified herein and in Section 05500 MISCELLANEOUS METAL FABRICATIONS. Overshot gate and appurtenant items shall be assembled for installation in strict accordance with the contract drawings, approved installation drawings, and shop match-markings. Before assembly and installation, all bearing surfaces requiring lubrication shall be thoroughly cleaned and lubricated with an approved lubricant. All components to be field-welded shall be in correct alignment before welding is commenced.

#### 3.1.1 Embedded Metals

Corner protection angles, sill angles, seal plates, frames, pedestals, bases and other embedded metal items required for proper and complete installation shall be accurately installed to the alignment and grade required to ensure accurate fitting and matching of components. Embedded metals shall be given a primer coat of the required paint on all surfaces prior to installation in concrete forms. Anchors for embedded metals shall be installed as shown. Items requiring two concrete pours for installation shall be attached to the embedded anchors after the initial pour, adjusted to the proper alignment, and concreted in place with the second pour. Welded field splices in sealing surfaces of embedded items shall be ground smooth.

#### 3.1.2 Lower Hinge Assembly

Base anchors for the lower hinge assembly shall be embedded in the first pour concrete. Base plate shall be attached to base anchors, set to the final position, and epoxy fill shall be placed in the void behind the base plates and allowed to reach the strength as shown and the approved field installation drawings. After the gate leaf is set in place, the hinge assembly shall be adjusted to provide for continuous contact between the sealing surfaces over the full height and length of the gate leaf. Allowances shall be made for the seals which shall not be attached until painting operations are completed. Second pour concrete shall be placed after final adjustments are completed.

### 3.1.3 Gate Leaf

Gate leaf components not assembled in the shop shall be assembled in the field as required for installation. Lower hinge assembly bearings shall be coated with grease prior to setting the gate leaf in place. All necessary precautions shall be taken to avoid distortion of the gate leaf or any component parts. Special care shall be exercised during installation to prevent any sag of the ends of the gate leaf due to compression of blocking or other causes. After the gate leaf has been set in place and the top hinge assembly installed, the gate leaf shall be plumbed and brought into correct position.

### 3.1.4 Painting

Exposed parts of overshot gate and appurtenances except machined surfaces, corrosion-resistant surfaces, surfaces of anchorages embedded in concrete, and other specified surfaces shall be painted as specified in Section 09964 PAINTING: HYDRAULIC STRUCTURES.

### 3.1.5 Seal Assemblies

Rubber seal assemblies shall be installed after the embedded metal components have been concreted in place and the overshot gate installation, including painting, completed. Rubber seals shall be fastened securely to metal retainers. Before operating the overshot gate, a suitable lubricant shall be applied to the rubber seal rubbing plates to protect the rubber.

## 3.2 PROTECTION OF FINISHED WORK

Protection of finished work shall conform to the requirements of Section 05500 MISCELLANEOUS METAL FABRICATIONS.

## 3.3 ACCEPTANCE TRIAL OPERATION

After completion of the overshot gate installation, the Contracting Officer will examine the gate for final acceptance. The overshot gate will be examined first to determine whether or not the workmanship conforms to the specification requirements. The Contractor will then be required to operate the overshot gate from the fully-opened to the fully-closed position a sufficient number of times to demonstrate that all parts are functioning properly. The workmanship in the fabrication and installation of overshot gate shall be such that the gate in the closed position will form a watertight barrier across the opening. Required repairs or replacements to correct defects, shall be made at no additional cost to the Government. The trial operation shall be repeated after defects are corrected. Prior to final acceptance of the overshot gate, the Contractor shall provide temporary restraints to prevent unauthorized operation of the overshot gate.

-- End of Section --



## SECTION 14601

## TAINTER GATE HOISTS

## PART 1 GENERAL

## 1.1 DESCRIPTION OF WORK

Provide a electric powered, single reeved, direct lifting, wire rope hoist that is complete, tested, and ready for operation. Hoist equipment, materials, installation, examination, inspection, and workmanship shall conform to the applicable requirements of NFPA 70, ASME HST-4, and CMAA 70, as modified and supplemented by this specification. References in these publications to the "authority having jurisdiction" means the "Contracting Officer."

## 1.2 REFERENCES

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

## AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9 (1990; R 2008) Load Ratings and Fatigue Life for Ball Bearings

ABMA 11 (1990; R 2008) Load Ratings and Fatigue Life for Roller Bearings

## AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 6013 (2006) Standard for Industrial Enclosed Gear Drives

## ASME INTERNATIONAL (ASME)

ASME HST-4 (1999; R 2004) Performance Standard for Overhead Electric Wire Rope Hoists

## ASTM INTERNATIONAL (ASTM)

ASTM A 1023/A 1023M (2007) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes

## CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70 (2004) Top Running and Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2007; Errata 2008) Standard for Motors and Generators

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(2011; Errata 2 2012) National Electrical  
Code

## 1.3 DEFINITIONS

Capacity shall mean the rated load in pounds, or tons of 2,000 pounds each, specified by the manufacturer for the hoist and marked plainly on the hoist so as to be clearly legible.

In determining the applied load, handling devices shall be included. Hoisting speed shall mean the velocity in feet per minute (fpm) at which the hoist will lift the rated load. Actual lifting speed shall be within plus or minus 10 percent of the manufacturer's rating.

Rated lift shall mean the distance between the upper and lower elevations of travel of the load pick point.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only.

## SD-02 Shop Drawings; G

Fabrication Drawings and Installation Drawings shall be submitted for hoist system including mounting plan to the deck structure.

## SD-03 Product Data

## Electric Wire Rope Hoist; G

Manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions, and parts list.

## SD-06 Test Reports

## Wire Rope Breaking Strength

## SD-07 Certificates

Compliance with All Listed Standards  
Loss of Power Test  
Hazardous Material  
Brake Settings

## SD-10 Operation and Maintenance Data; G

Submit an operation and Maintenance Manual 30 calendar days prior to the testing of the electric wire rope hoist system. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to Contract completion. Manual shall include information on preventative maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information

necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Provide routine preventative maintenance instructions, and equipment required. Provide instruction on how to modify program settings.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Certificates

- A. Certification of minimum wire rope breaking strength for each hoist, with traceable identification for each hoist installed. Where applicable, submit factory certification of the wire rope rated capacity.
- B. Certification that testing may be performed in which hoist system is subjected to a Loss of Power Test during operation with no detrimental effects.
- C. Certification that the hoist system contains no hazardous material, asbestos, cadmium, lead, elemental mercury, or PCBs.
- D. Certification that the hoist, hook, and trolley system design and fabrication is in compliance with all listed standards.
- E. Certification of brake settings, including the allowable range of adjustment for hoist system and the initial setting.

### 1.5.2 Pre-Erection Inspection

Before erection, the Contractor shall inspect the hoist system and components in the shop to determine compliance with specifications and manufacturer's data and shop drawings approved.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### 1.6.1 Delivery and Storage

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage or corrosion during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. When special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.

### 1.6.2 Handling

Handle materials in such a manner as to ensure delivery to final location in undamaged condition. Make repairs to damaged materials at no cost to Government.

## PART 2 PRODUCTS

### 2.1 IDENTIFICATION PLATES

Provide manufacturer installed identification plates of non-corrosive metal

showing, in clearly legible permanent lettering, the manufacturer's name, model number, capacity rating in pounds, and other essential information.

## 2.2 CAPACITY AND SPEED

Provide a hoist system with a minimum rated capacity of 15 tons and a minimum rated lift of 12 feet. Hoist rated speed shall be 1.75 fpm. Hoist motors shall be 230 Volt, 3-Phase, 60-Hertz.

## 2.3 ELECTRIC WIRE ROPE HOIST

### 2.3.1 Hoisting Ropes

Provide the following:

- a. Rope lengths sufficient to maintain a minimum of two full wraps of rope at the dead end of the drum, with the fast line clevis in its lowest indicated position.
- b. Hoisting ropes shall conform to ASTM A 1023/A 1023M, improved or extra improved plow steel, regular lay, galvanized, 6 by 37 class construction, with an independent wire rope core. Provide proof of wire rope breaking strength test report.
- c. Conform to ASME HST-4, Class H3, except as modified herein. All hoists shall be single reeved, direct lifting type, as in the drawings.

### 2.3.2 Drum

Provide steel or ductile cast iron drum. Pitch diameter of the drum shall not be less than 18 times the rope diameter. A minimum of two dead wraps of the hoisting rope shall remain on each anchorage when the fast line clevis is in its extreme low position. Contact surfaces of drum shall be galvanized.

### 2.3.3 Motors

Provide 230 VAC, 60 Hz totally enclosed, fan cooled (TEFC), squirrel cage induction type NEMA B hoist motors. Motors shall conform to NEMA MG 1. All motors shall be continuous duty and rated for full-voltage starting. Motor installation shall be Class H with a Class B temperature rise. Equip all motors with thermal trip-type over-temperature protection.

### 2.3.4 Gear Drives

Gear drive shall be worm, spur, helical, spiral, or bevel type, accurately machined, and conforming to AGMA standards for this type of service. Gear shafts shall be manufactured from high carbon-steel or alloy steel, machined and ground for accurate fit. Gear train assembly shall be totally enclosed in the gear reducer housing and shall operate in a sealed oil bath. Frame casting shall be provided with lubrication fittings and inspection ports.

### 2.3.5 Lubrication

Adequate lubrication shall be provided for moving parts of the hoist and for filling, draining, and checking the level of the lubricant. Lubricant shall be designed for use in an ambient temperature of 10 to 110 degrees F. Lubrication and mechanism housing seals shall prevent leaking and lubricant

from coming into contact with electrical motors and equipment. Lubricant shall conform to AGMA 6013.

#### 2.3.6 Motor Bearings

Motor bearings shall be heavy-duty ball or roller antifriction type for the specific duty load. Bearings shall have a minimum 90-percent bearing rating of 3,000 hours as defined by ABMA 9 or ABMA 11 as applicable.

Bearings in motors shall be pre-lubricated and equipped with lubrication service fittings and with provision for automatic positive relief of lubrication pressure, accomplished by either built-in relief devices or automatic ball-and-spring relief fittings at the bottom of the bearing housing. Pressure relief shall be to the outside of the housing. Lubrication fittings shall be fitted with color-coded plastic or metal dust caps.

Bearings in any motor lubricated at the factory for extended duty periods shall be so identified with labels or tags. Tag shall state that the motor shall not be lubricated for a given number of operating hours.

#### 2.3.7 Limit Switches

Rotary, adjustable upper and lower limit switches shall be provided to prevent over travel of the hoist in either direction. Limit switches shall be arranged to stop the hoist motor and apply the motor brake before reaching the uppermost or lowermost safe limit of travel. In case of overtravel, the motor shall be automatically stopped. For additional limit switch details, see SECTION 16905, ELECTRICAL EQUIPMENT FOR GATE HOIST.

#### 2.3.8 Motor Brake

Motor brake shall be an externally adjustable, electrically-operated shoe or multiple-friction disk brake that shall apply automatically when the power is off.

Motor brake shall be capable of stopping and safely holding 125 percent of the rated load from any operating speed. Brake shall hold a static load equal to 150 percent of the rated capacity of the hoist.

The releasing magnet shall be of the AC shunt type and of standard stock design, suitable for operation on 230-volt, 60 Hz, AC electrical power. The complete unit shall be suitable for connection to the control circuit or the power circuit of the motor with which the brake is used so that the brake will set or release when the motor is deenergized or energized, respectively.

A hand release shall be provided for the brake. It shall be operable only when the enclosing case cover is removed and shall be self-resetting.

#### 2.3.9 Wire Rope Sockets and Turnbuckles

Wire rope socket and turnbuckles shall be of the type and arrangement as shown in the drawings. Sockets and turnbuckles shall be galvanized. Turnbuckle shall have minimum adjustment of 8 inches. Turnbuckles shall be provided with spacers to avoid clearance between turnbuckle jaw and lifting bracket.

### 2.3.10 Hoist Mounting

Hoist components shall be mounted on structural steel base. The hoist assembly along with structural steel base shall be mounted on concrete deck structure. Mounting plan showing mounting location shall be provided.

### 2.3.11 Paint Finish

Each hoist, and accessory shall receive a factory-applied manufacturer standard paint finish for exterior (outdoor) operation. Provide a primer and a finish coat. Blast clean all components prior to painting.

### 2.3.12 Controls

Refer to SECTION 16905, ELECTRICAL EQUIPMENT FOR GATE HOIST.

## 2.4 SHOP ASSEMBLY AND TESTS

### 2.4.1 General

Each machinery unit shall be completely assembled on its structural steel base in the shop and tested in the presence of a representative of the Contracting Officer. Notify the Contracting Officer at least 10 calendar days before testing of each machinery unit. This notification shall include information on how many units will be tested and the estimated time frame involved with each test. The witnessing of a particular test may be waived by the Contracting Officer. However, the approved shop test procedures, notification, and documentation shall still be performed as required by these specifications. Once informed that Government personnel will witness the test(s), notify the Contracting Officer that a particular test is scheduled as planned a minimum of 48 hours prior to the test(s). Perform all necessary preparations and preliminary testing prior to issuing the 48-hour notification. Testing shall commence upon the arrival of Government personnel at the scheduled location and time. Design and furnish a test rig and facilities (within the continental United States) suitable for performing the tests. Details of the test rig and its location shall be submitted for evaluation and approval of the Contracting Officer. The submittal shall address aspects including adequacy of rig strength, foundations, access to the test rig, availability of suitable power and cranes, how the work will be protected, how the test measurements will be made, and how test results can be verified. All bearing surfaces and lubrication lines shall be cleaned and reducer bearings, couplings, and gears properly lubricated before tests are begun. All speed reducers shall be properly filled with the lubricating oil; and transfer of lubricating oil from one unit to another will not be allowed. The motors, brakes, and controls shall be electrically connected and operated at rated voltage. The motor, speed reducer, and brake machinery components shall be tested and shipped to the job-site fully assembled on the structural steel base (machinery base as indicated on the Contract Drawings). Machinery that is tested or arrives on site without the machinery base installed will be rejected.

### 2.4.2 Test Procedure

Submit the test procedure, with a blank test results data sheet, to the Contracting Officer for review and approval prior to the commencement of any tests. The test procedure applies to all units and shall include raising and lowering a 15-ton test load vertically through a distance of 12 feet. The load shall be suspended from the actual hoisting wire ropes.

The load shall be raised and lowered three times in succession without significant interruption. The wire rope drums shall be inspected to ensure proper reeving of the wire rope. Each piece of equipment shall be inspected for smooth operation and proper alignment and all necessary clearances checked to ensure binding or excessive heat does not occur in any moving part. During the test, readings of motor current, RPM, voltage, and temperature shall be provided to the Contracting Officer. The test shall be stopped immediately if there is any undue noise, vibration, or heat developed in any of the bearings. After correction of alignment and/or all other causes for the interruption of the test, the unit shall be re-inspected and testing shall resume when permitted by the Contracting Officer. Final operating test results for each unit shall be submitted to the Contracting Officer.

### PART 3 EXECUTION

#### 3.1 ERECTION AND INSTALLATION

Manufacturer's Instructions shall include details of installation, operation, maintenance, and repair of hoist systems. Repair section shall contain replacement part numbers for the entire assembly. Installation Drawings shall indicate power source, location of controls, headroom, clearance, and pick point center-to-center distance and lift requirements. Drawings shall also indicate capacity, weights, dimensions, hoisting rope, shafts, bearings, drums, turnbuckles, reeving, motor description and characteristics, limit switches, brakes, and wiring. Connections shall be bolted connections.

#### 3.2 FIELD ERECTION AND TESTS

Field erection and field tests will be made by and at the expense of the Contractor under the general supervision of the Erecting Engineer, to be furnished by the Contractor under the provisions of the paragraph titled "ERECTING ENGINEER." Submit the Field Tensioning and Operating Test Procedure, with a blank test results data sheet, to the Contracting Officer for review and approval prior to the commencement of any field tests. The wire rope field tensioning procedure shall be based on the following steps. Upon connection of the wire rope to the gate, equalize the tension in the cables by the use of a deflection-type cable tension indicator mounted to each cable. After each adjustment of a set of wire ropes, the gate shall be raised one foot above the sill and the cables checked for uniform tension. Equal tensioning will be considered achieved when the tension of the cables is within 5 percent of the mean tension per rope for that set of wire ropes. The load supporting each side of the gate shall not be less than 48 percent nor more than 52 percent of the total load. Adjustments shall be repeated until the wire ropes have been correctly tensioned. After the units have been installed and final alignment and grouting are made and the field tensioning tests are complete, each complete unit will be operated and the gate fully raised and lowered a sufficient number of 3 cycles. During the test, readings of motor RPM, current, and voltage shall be provided to the Contracting Officer as data to enable estimation of the motor horsepower developed. Final operating test results for each unit shall be submitted to the Contracting Officer.

#### 3.3 ERECTING ENGINEER

- A. Furnish the services of a competent Erecting Engineer to supervise and direct the erection and installation of this equipment. The Erecting Engineer shall be present for all field erection, inspections, and

tests.

- B. The Erecting Engineer has sole responsibility for the equipment meeting all the requirements of these specifications and fulfilling all the Contractor's guarantees.
- C. The Erecting Engineer shall verify the fit and alignment of mating components prior to erecting in the field and be present during final connection and field testing for Contract compliance. The Erecting Engineer shall keep records of all measurements taken during installation and testing.

#### 3.4 FIELD TRAINING

Field training shall be provided for operating staff after each system is functionally complete but prior to final acceptance. The training shall be given for a period of 4 hours. The training shall cover all pieces of equipment and shall include items contained in the operation and maintenance manuals.

#### 3.5 ACCEPTANCE

Upon successful completion of the field tests, the gate hoist machinery and accessory items and equipment will be examined by the GQAR, and, if found to comply with the Contract, they will be accepted and the Contractor will be furnished written notice of such acceptance.

-- End of Section --



## SECTION 16050

## BASIC ELECTRICAL MATERIALS AND METHODS

## PART 1 GENERAL

## 1.1 REFERENCES

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

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) National Electrical Safety Code

IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

## 1.2 RELATED REQUIREMENTS

SECTION 16050, BASIC ELECTRICAL MATERIALS AND METHODS  
SECTION 16051, COMMON WORK RESULTS FOR ELECTRICAL  
SECTION 16065, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY  
SECTION 16070, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT  
SECTION 16071, LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES  
SECTION 16120, INSULATED WIRE AND CABLE  
SECTION 16436, AUTOMATIC TRANSFER SWITCHES  
SECTION 16445, SWITCHGEAR AND PROTECTION DEVICES  
SECTION 16905, ELECTRICAL EQUIPMENT FOR GATE HOIST

## 1.3 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.
- B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that

describe products, systems, installation procedures, equipment, and test methods.

#### 1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 240 volts, 60 Hz three phase, four wire. Final connections to the distribution panel shall be made by the Contractor.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

##### SD-02 Shop Drawings

Wiring Diagrams; G

Installation Details; G

Layout Drawings; G

Shop Drawings

#### 1.6 QUALITY ASSURANCE

##### 1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

##### 1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

##### 1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable

if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the Contract.

#### 1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

#### 1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. For additional nameplate requirements, see SECTION 16051, COMMON WORK RESULTS FOR ELECTRICAL.

#### 1.10 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

#### 1.11 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government

personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

## PART 2 PRODUCTS

### 2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

### 2.2 WIRING DIAGRAMS, INSTALLATION DETAILS, LAYOUT DRAWINGS, AND SHOP DRAWINGS

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

## PART 3 EXECUTION

### 3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment. Touch-up paint shall be applied to surfaces damaged during installation.

### 3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

### 3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

## SECTION 16051

## COMMON WORK RESULTS FOR ELECTRICAL

## 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 within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

## INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 (2003; R 2004) Standard for Accessible and Usable Buildings and Facilities

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1 (2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

NEMA OS 1 (2008) Standard for Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA RN 1 (2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2 (2003) Standard for Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

NEMA TC 3 (2004) Standard for Polyvinyl Chloride PVC Fittings for Use With Rigid PVC Conduit and Tubing

NEMA WD 6 (2002; R 2008) Standard for Wiring Devices - Dimensional Requirements

NEMA Z535.1 (2006) Standard for Safety Colors

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

UL 1 (2005; Rev thru Jul 2007) Standard for Flexible Metal Conduit

UL 489 (2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 506 (2008; Rev thru Dec 2009) Standard for Specialty Transformers

UL 6 (2007) Standard for Electrical Rigid Metal Conduit-Steel

UL 870 (1995; Rev thru Jul 2003) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

## SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceways, and Fittings  
Splices and Connectors  
Switches  
Receptacles  
Outlets, Outlet Boxes, and Pull Boxes  
Circuit Breakers  
Lamps and Luminaires

## SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceways, and Fittings  
Splices and Connectors  
Switches; G  
Receptacles  
Outlets, Outlet Boxes, and Pull Boxes  
Circuit Breakers  
Lamps and Luminaires; G  
Spare Parts

## SD-06 Test Reports

Continuity Test; G  
Insulation Resistance Test; G

SD-07 Certificates

Certification

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

### 1.3 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For all outdoor installations, refer to SECTION 09964, PAINTING: HYDRAULIC STRUCTURES. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

### 1.4 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.
- B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- C. Vertical assembly. A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 135-mph wind loading.

### 1.5 GENERAL REQUIREMENTS

Submit Material, Equipment, and Luminaires schedule for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit Manufacturer's Instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit Certification required to install equipment components and system packages.

### 1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

#### 1.7 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

##### 2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process after threading. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run



where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

#### 2.1.2 Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

#### 2.1.3 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

#### 2.1.4 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4-inch trade size conforming to UL 870.

### 2.2 WIRE AND CABLE

See SECTION 16120, INSULATED WIRE AND CABLE.

### 2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved insulated electrical type.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

### 2.4 SWITCHES

#### 2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to NEMA Z535.1.

## 2.5 RECEPTACLES

Receptacles shall be GFCI, weatherproof commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

## 2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 and NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers. For junction boxes located outside, furnish junction box with gasket.

## 2.7 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated on the Contract Drawings and in no event less than 20,000 amperes root-mean-square (rms) symmetrical at 240 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

## 2.8 LAMPS AND LUMINAIRES

Manufacturers and catalog numbers shown are indicative of the general type desired and are not intended to restrict the selection to fixtures of any particular manufacturer. Luminaires with the same salient features and equivalent light distribution and brightness characteristics of approved finish and quality, are acceptable. Provide lamps of the proper type and wattage for each luminaire.

High intensity discharge (HID) lighting luminaires shall have prewired integral ballasts and cast aluminum housings complete with tempered glass lenses suitable for installation in damp or wet locations. Provide luminaires and lamps.

## 2.9 DRY-TYPE DISTRIBUTION TRANSFORMERS

General purpose dry-type transformers with windings 600 volts or less shall be two-winding, 60 hertz, self-cooled in accordance with UL 506. Windings shall have a minimum of two 2-1/2-percent taps above and below nominal voltage. Windings shall be copper.

# PART 3 EXECUTION

## 3.1 CONDUITS, RACEWAYS, AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or replace conduit.

### 3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

### 3.1.2 Electrical Metallic Tubing (EMT)

EMT shall not be permitted.

### 3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect transformers and other approved assemblies.

Bonding wires and ground conductor shall be used in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

### 3.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

### 3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be permitted for use in concrete embedment only.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70. For additional information, see Section 16065, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

## 3.2 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4-inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

## 3.3 WIRING DEVICES

### 3.3.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

### 3.3.2 Receptacle Plates

Receptacle plates shall be suitably engraved with a description of the loads.

Receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4-inch embossed letters.

Receptacle plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

### 3.4 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of outlets and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC A117.1 at 18 inches minimum.

### 3.5 DRY-TYPE DISTRIBUTION TRANSFORMERS

Connect dry-type transformers with flexible metallic conduit.

Mount all dry-type transformers on vibration isolators.

### 3.6 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall also have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source.

### 3.7 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in SECTION 09964, PAINTING: HYDRAULIC STRUCTURES.

### 3.8 FIELD TESTING

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panelboards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform Insulation-Resistance Test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts DC for 300-volt rated cable and 1,000 volts DC for 600-volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300-volt rated cable and 100 Megohms for 600-volt rated cable. For circuits with conductor sizes No. 8 AWG and smaller insulation resistance testing is not required.

Perform Continuity Test to insure correct cable connection (i.e., correct phase conductor, grounded conductor, and grounding conductor wiring) end-to-end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at Contractor's expense. All repairs shall be approved by the Contracting Officer prior to acceptance of the repair.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the Contracting Officer.

-- End of Section --

## SECTION 16065

## GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

## 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 within the text by the basic designation only.

## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2004; Errata 2004) Specification for  
Filler Metals for Brazing and Braze Welding

## ASTM INTERNATIONAL (ASTM)

ASTM B 3 (2001; R 2007) Standard Specification for  
Soft or Annealed Copper Wire

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 81 (1983) Guide for Measuring Earth  
Resistivity, Ground Impedance, and Earth  
Surface Potentials of a Ground System  
(Part 1) Normal Measurements

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical  
Code

## U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-889 (Rev B, Notice 3) Dissimilar Metals

## UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Standard for Grounding and Bonding  
Equipment

## 1.2 GENERAL REQUIREMENTS

SECTION 16050, BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

## 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. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit material, equipment, and fixture lists for Grounding Systems including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

#### SD-02 Shop Drawings

Submit Record Drawings in accordance with paragraph entitled, "DRAWINGS," of this section.

#### SD-03 Product Data

Submit equipment and performance data for the following items including life, test, system functional flows, safety features, and mechanical automated details.

Submit Manufacturer's catalog data for the following items:

- Ground Rods
- Ground Wires
- Connectors and Fasteners
- Bonding

#### SD-06 Test Reports

Submit Test Reports for the following tests on grounding systems in accordance with the paragraph entitled, "FIELD TESTS," of this section. Within the report include certified record of ground-resistance tests on each driven ground rod, ground rod assembly, and other grounding electrodes. Include within the record the number of rods driven and their depth at each location to meet the required resistance-to-ground measurements specified. Include a statement describing the condition of the soil at the time of measurement.

- Bond Resistance Test
- Ground Resistance Tests
- Ground Isolation Test
- Continuity Isolation Test

#### SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions for the Grounding Systems including special provisions required to install equipment components and system packages. Within special notices, detail impedances, hazards and safety precautions.

### 1.4 DRAWINGS

Record Drawings must indicate the location of ground rods, mats, grids, building ground bus, supplementary grounding electrodes, steel building columns, and other metal structures connected to the grounding system.

Identify the location of each ground rod and ground-rod assembly and other grounding electrodes by letter in alphabetical order and keyed to the record of ground-resistance tests.

## PART 2 PRODUCTS

### 2.1 GROUND RODS

Ground rods must be copper-clad steel rods not less than 3/4 inch in diameter and not less than 10 feet long per section. Ground rods must be clean and smooth and have a cone-shaped point on the first section and be die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in feet.

### 2.2 GROUND WIRES

Ground wires must be in accordance with SECTION 16051, COMMON WORK RESULTS FOR ELECTRICAL.

Ground and bond wires for substations, main panels and distribution points, and ground rod connections must be annealed bare copper conforming to ASTM B 3, stranded, with 98-percent conductivity. Wire size must be in accordance with the grounding requirements of NFPA 70.

Ground wires for equipment receptacles for noncurrent-carrying hardware, installed in conduit must be soft drawn copper, in accordance with ASTM B 3, stranded, with green insulation. Note wire size.

### 2.3 CONNECTORS AND FASTENERS

Grounding and bonding fasteners and connectors must conform to the requirements of UL 467, and SECTION 16051, COMMON WORK RESULTS FOR ELECTRICAL.

Grounding and bonding fasteners must be copper.

Bonding straps and jumpers must be copper and have a cross-sectional area of not less than No. 6 AWG. Bonding straps and jumpers for shock-mounted devices with hinged joints must be made of woven-wire braid wire.

## PART 3 EXECUTION

### 3.1 BONDING AND GROUNDING

Bonding and grounding requirements must be in accordance with NFPA 70.

### 3.2 GROUNDING ELECTRODES

Grounding electrodes must include ground rods installed expressly for grounding systems.

Minimum ground rod section must be 10 feet. Thread sections together and exothermically fusion weld.

Install ground rods so that the top of the rod is not less than 18 inches below finished grade.

### 3.3 BUILDING GROUNDS

Building ground system is existing to remain. Identify locations for connection of new system electrical to existing ground system.



### 3.4 EQUIPMENT GROUNDING

In addition to the green colored equipment grounding conductor required in each raceway and sized in accordance with Table 250.122 of the NEC, each electrical enclosure, transformer housing, motor housing, disconnect, starter, and other electrical equipment, addressed under this Contract, must be bonded to the grounding system with a stranded copper conductor, routed external to the feeder raceway.

Metallic raceway systems must have electrical continuity with equipment individually and be directly connected to the building ground, independent of the raceway system.

Individually and directly connect electrical enclosures to the building ground. Grounding conductor must not be less than No. 2 AWG and be connected from the building ground to a copper ground-bus terminal strip located in each enclosure.

Polarized receptacles, lighting fixtures, and equipment enclosures must be grounded with an identified (green color) insulated conductor, not smaller than No. 12 AWG, connected to the branch circuit ground-bus terminal strip. Ground-bus terminal strip in each panelboard enclosure must be isolated and independent of the system neutral terminal strip.

Indoor transformers, switchboard frames, switchgear assemblies, motors, motor control enclosures, generators, must be individually and directly connected to the building ground. Current-carrying capacity of the grounding conductor must be in accordance with NFPA 70.

Noncurrent-carrying metallic parts of electrical equipment, including metallic cable sheaths, conduit, raceways, and electrical structural members, must be bonded together and connected to the ground grid or ground connection rods.

Connect to the existing ground systems for power and instrumentation. Independently connect each system to the building ground system.

Secure ground systems must consist of unspliced ground wires in individual welded or epoxied conduit runs from the secure area to the building counterpoise. Welding and epoxying must conform to SECTION 16051, COMMON WORK RESULTS FOR ELECTRICAL.

### 3.5 GROUNDING CONNECTIONS

Ground connections must be bonded connections in accordance with paragraph entitled, "BONDING."

Weld ground connections that are buried or in inaccessible locations.

Bolt connections in accessible locations. Connections to steel building columns in accessible locations must be cast-copper-alloy clamp lugs exothermically fusion-welded to the structure.

Clean, grease, and remove foreign matter from ground connection surfaces. Do not penetrate clad material in the cleaning process. Make connection between like metals where possible. Where dissimilar metals are welded, brazed, or clamped, follow the weld kit manufacturer's instructions. Connections between dissimilar metals must not produce galvanic action in accordance with MIL-STD-889.

### 3.6 BONDING

#### 3.6.1 Type of Bonds

Accomplish bonding of metal surfaces by brazing, welding, or clamping.

##### 3.6.1.1 Brazing

Brazing solder must conform to AWS A5.8/A5.8M.

##### 3.6.1.2 Welding

Welding must be by the exothermic process. Within the welding procedure, include the proper mold and powder charge and conform to the manufacturer's recommendations.

Welding processes must be of the exothermic fusion type that will make a connection without corroding or loosening. Process must join all strands and not cause the parts to be damaged or weakened. Completed connection or joint must be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor. Paint buried ground connections with a bitumastic paint.

##### 3.6.1.3 Clamping

In external locations, use clamping only where a disconnect type of connection is required. Connection device may utilize threaded fasteners. Construct device such that positive contact pressure is maintained at all times. Use machine bolts with tooth-type lockwashers.

#### 3.6.2 Cleaning of Bonding Surfaces

Thoroughly clean surfaces that comprise the bond before joining. Apply an appropriate abrasive with gentle and uniform pressure to ensure a smooth and uniform surface. Do not remove excessive metal from the surface. Clean clad metals in such a manner that the cladding material is not penetrated by the cleaning process. Then clean bare metal with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, and other contaminants. Bond to the cleaned area must be made within one hour after cleaning. Seal joint and refinish the exposed surfaces within two hours of exposure to prevent oxidation. When additional time is required, apply a corrosion preventive compound until the area can be refinished.

#### 3.6.3 Bonding Straps and Jumpers

Install jumpers such that the vibration by the shock-mounted device will not change its electrical characteristics.

Braze or Weld bonds for outdoor locations unless a disconnect type of connection is required. When a disconnect is required, use clamping with bolts. Insert a tooth-type lockwasher between the strap and metallic member for each bolt.

Bond straps directly to the basic structure and do not penetrate any adjacent parts. Install straps in an area that is accessible for maintenance.

Use single straps for the bonds and install such that they will not restrict movement of structural members. Do not connect two or more straps in series.

Install straps such that they will not weaken structural members to which they are attached.

#### 3.6.4 Equipment and Enclosure Bonding

Each metallic enclosure and all electrical equipment must be bonded to ground. At least one copper connection must be made from the system ground point to one or more enclosures in the area such that all enclosures and equipment provide a low-impedance path to ground when properly bonded together.

#### 3.6.5 Bonding of Conduit and Raceway Systems

Bond all metal conduit, fittings, junction boxes, outlet boxes, armored and metal sheathed cable, and other raceways. Take care to ensure adequate electrical contact at the joints and terminations.

##### 3.6.5.1 Rigid Metal Conduit and Terminations

Threaded connections must be wrench-tight and there must be no exposed threads. Ream all ends of the conduit to remove burrs and rough edges. Conduits entering boxes and enclosures must be bonded to the box with locknuts and grounding-type bushings. Locknuts that gouge into the metal box when tightened are not acceptable.

##### 3.6.5.2 Flexible Metal Conduit

Flexible conduit must have an integral grounding conductor.

#### 3.6.6 Cable Tray Bonding

Bond cable tray sections together. Cable tray sections in tandem assembly must be considered as having electrical continuity when these sections are bonded with the appropriate bolts. Install bond straps across expansion joints. Bond cable trays to the building ground system.

#### 3.6.7 Protection of Finished Bonds

Protect finished bonds by painting to match the original finish after the bond is made.

### 3.7 FIELD TESTS

Perform the following tests in the presence of the Contracting Officer or Contracting Officer's Technical Representative.

#### 3.7.1 Bond Resistance Test

Resistance of any bond connection must not exceed 0.5 milliohm. Rework bonds that exceed this resistance at no additional cost to the Government.

#### 3.7.2 Ground Resistance Tests

Test Grounding systems for ground resistance. Total resistance from any point on the ground network to the building counterpoise must not exceed 25

milliohms.

Ground resistance and counterpoise tests must be made during dry weather, and no sooner than 48 hours after rainfall. Conduct tests using the ratio method that measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Perform measurements in accordance with IEEE Std 81.

Indicating instrument must be self-contained and include a direct-current generator, synchronized current and potential reversers, crossed-current and potential coils, direct-reading ohmmeter, series resistors, and range-selector switch. Calibrate direct-reading ohmmeter for ranges of 0 to 20 ohms and 0 to 200 ohms.

Place auxiliary grounding electrodes in accordance with instrument manufacturer's recommendations but not less than 50 feet apart, in accordance with IEEE Std 81.

### 3.7.3 Ground Isolation Test

Test ground systems for isolation from other ground systems.

### 3.7.4 Continuity Isolation Test

Perform continuity test on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

-- End of Section --

## SECTION 16070

## SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2005) Manual of Steel Construction

## ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M (2008) Standard Specification for Carbon Structural Steel

ASTM A 53/A 53M (2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 500/A 500M (2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 572/A 572M (2007) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

## U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2007; Change 1) Seismic Design for Buildings

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

TI 809-04 (1998) USACE, Technical Instructions for Seismic Design for Buildings

## UNDERWRITERS LABORATORIES (UL)

UL 1598 (2008; Rev thru Jan 2010) Luminaires

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below.

### 1.2.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

- Starter Panel
- Control Panel
- Light Fixtures
- Transfer Switch
- Disconnect Switches

### 1.2.3 Electrical Systems

The following electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

### 1.2.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 shall be used for the design. The bracing for the following electrical equipment and systems shall be developed by the Contractor: Control Panels, Transformers, Automatic Transfer Switches.

### 1.2.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other conduits shall be seismically protected as specified.

## 1.3 EQUIPMENT REQUIREMENTS

### 1.3.1 Rigidly Mounted Equipment

The following specific items of equipment: new control panel, new starter panel, transformers, power panels, transfer switches and motors to be furnished under this Contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

###### Equipment Requirements; G

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

##### SD-03 Product Data

###### Equipment Requirements; G

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a Registered Professional Engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

###### Contractor Designed Bracing; G

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

#### PART 2 PRODUCTS

##### 2.1 GENERAL SEISMIC PROTECTION REQUIREMENTS

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below.

###### 2.1.1 Rigidly Mounted Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

- Starter Panel
- Control Panel
- Disconnect Switches
- Transfer Switch
- Light Fixtures

##### 2.2 EQUIPMENT REQUIREMENTS

###### 2.2.1 Rigidly Mounted Equipment

The electrical equipment furnished and installed under this Contract shall be constructed and assembled to withstand the seismic forces specified in

TI 809-04, Chapter 10. For any rigid equipment which is rigidly attached on both sides of an expansion joint, flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions, shall be provided.

### 2.3 LIGHT FIXTURE SUPPORTS

Light fixtures and supports shall conform to UL 1598.

### 2.4 SWAY BRACING MATERIALS

Material used for members listed in this section, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A 36/A 36M, or ASTM A 572/A 572M, Grade 503.
- b. Tubes, ASTM A 500/A 500M, Grade B.
- c. Pipes, ASTM A 53/A 53M, Type E or S, Grade B.
- d. Light gauge angles, less than 1/4-inch thickness, ASTM A 653/A 653M.

## PART 3 EXECUTION

### 3.1 GENERAL

Contractor shall submit detailed shop drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for rigidly mounted equipment. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

### 3.2 SEISMIC SWAY BRACING

#### 3.2.1 Sway Bracing Design Requirements

Sway bracing conforming with the requirements of these specifications shall be designed and provided for both mechanical and electrical systems. Seismic forces shall be applied both in lateral and vertical directions. Design of sway braces shall be based on the water filled weight of pipe combined with the seismic forces. Design of sway braces for electrical conduit or raceways shall be based on the design weight of the completely filled conduit or raceway.

#### 3.2.2 Sway Bracing Required for Systems

Sway bracing shall be provided for all suspended systems with the following exceptions. Sway bracing shall be provided for all conduit larger than 3 inches in diameter. Sway bracing shall be provided at junctions, and at horizontal or vertical transitions for electrical service raceways and bus ducts.

#### 3.2.3 Sway Bracing Required for Equipment

Sway bracing shall be provided for equipment supported from overhead structural systems.



### 3.3 SWAY BRACES FOR CONDUIT

#### 3.3.1 General

Conduit shall be braced as for an equivalent weight pipe. Sway bracing shall consist of transverse, longitudinal, and 4-way braces. Conduit system shall be designed such that sway bracing attachment and configuration does not interfere with thermal expansion of the conduit. Sway bracing shall be provided at junctions, and at horizontal or vertical transitions for electrical raceways.

#### 3.3.2 Transverse Braces

Transverse sway braces for conduit shall be provided at every fourth hanger for diameter sizes 1/4-inch through 2 1/2 inches and at every third hanger for pipe diameter sizes 3-inch through 8-inch. Transverse sway braces shall be provided for bus ducts and electrical raceways at vertical or horizontal transitions. Vertical systems shall be braced at not more than 20-foot intervals and the bracing shall be located above the center of gravity of the item being braced.

#### 3.3.3 Longitudinal or Four-Way Braces

Longitudinal braces or four-way braces shall be provided at least once per monolith. Longitudinal or four-way braces shall be provided at least once per straight length of conduit that is greater than 10 feet in length. Four-way sway braces shall be provided for bus ducts and electrical raceways at junctions.

#### 3.3.4 Seismic Isolation for Conduit Systems

Spreaders or rack type hangers shall be provided between adjacent conduit runs to prevent contact during seismic activity whenever conduit surfaces are less than 4 inches apart and shall be provided at the same interval as sway bracing at an equal distance between sway braces.

### 3.4 LIGHT FIXTURE SUPPORTS AND BRACING

Light fixture supports shall conform to the requirements of UL 1598. Structural requirements for light fixture bracing shall conform to the requirements above.

-- End of Section --

## SECTION 16071

## LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

## 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 within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM D 877 (2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 443 (1979) Standard for Solid-State Relay Service, EIA/NARM

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.17 (1997) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers

IEEE C37.90 (2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus

IEEE C57.13 (2008) Standard Requirements for Instrument Transformers

IEEE C63.2 (2009) Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications

IEEE C63.4 (2009) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

## IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC D330 (1992) Switches

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 107 (1998; R 1993) Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus

NEMA 250 (2008) Enclosures for Electrical Equipment

(1000 Volts Maximum)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA AB 3	(2001) Molded Case Circuit Breakers and Their Application
NEMA C12.1	(2008) Electric Meters; Code for Electricity Metering
NEMA C78.23	(1995; R 2003) Standard for Incandescent Lamps - Miscellaneous Types
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2001; R 2006) Standard for Enclosures

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
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#### UNDERWRITERS LABORATORIES (UL)

UL 20	(2000 ; Rev thru Dec 2008) Standard for General-Use Snap Switches
UL 489	(2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(1999; Rev thru Sep 2008) Standard for Industrial Control Equipment

### 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 reviews the submittal for the Government. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

## Fuses

## SD-02 Shop Drawings

Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "GENERAL REQUIREMENTS," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "INSTALLATION," of this section.

Control Devices  
Protective Devices

## SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Control  
Instrument Transformers  
Enclosures  
Circuit Breakers  
Control Devices  
Pushbuttons and Switches  
Protective Relays  
Indicating Lights

## SD-07 Certificates

Submit certificates for Circuit Tests on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include dielectric tests.

## SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices  
Protective Devices

## SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Motor Control  
Magnetic Motor Controllers  
Combination Motor Controllers  
Circuit Breakers  
Pushbuttons and Switches

## Protective Relays

### 1.3 GENERAL REQUIREMENTS

SECTION 16050, BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

## PART 2 PRODUCTS

### 2.1 MOTOR CONTROL

Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Provide controllers that have thermal overload protection in each phase.

#### 2.1.1 Magnetic Motor Controllers

##### 2.1.1.1 Full-Voltage Controllers

Provide full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508 for magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60-hertz motor control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Include three manual reset thermal overload devices for overcurrent protection, one in each pole of the controller. Provide thermal overload relays of melting-alloy type with continuous current ratings and service-limit current ratings, and with a plus or minus 15-percent adjustment to compensate for ambient operating conditions, and 25 percent for 1.15 service factor motors.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide enclosure in accordance with NEMA 250, Type 12.

#### 2.1.1.2 Reduced-Voltage Starters

Conform to the requirements for full-voltage controllers for reduced-voltage starters, except for voltage, and to the following additional requirements.

Fully protect the motor during all phases of motor starting with an overload device in each motor leg. Rate starter contacts to withstand the switching surges during selector to full voltage. Provide starter that contains the necessary sensing and timing devices to monitor motor operation and select the correct time for selector to full voltage.

Adequately ventilate resistors and autotransformers used for starting. Ventilate solid-state starters for starting cycles as well as any follow-on restart-run cycles. Operate external control circuits or solid-state starters at a maximum of 120 volts AC.

For solid-state starters, provide adjustable starting torque from 0 to 50 percent of applied voltage, minimum. Provide autotransformer starters with a minimum of three taps above 50-percent reduced voltage.

#### 2.1.2 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures" for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers for molded-case circuit breakers.

Provide control-power transformers 120-volt AC maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

##### 2.1.2.1 Reversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For reversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include two interlocked magnetic controllers with molded-case circuit breaker or MCP, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the forward and reverse running connection of the

motor controller.

Provide rating of three-phase single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

## 2.2 INSTRUMENT TRANSFORMERS

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2, IEEE C63.4, and NEMA 107 for instrument transformers.

Insulation Class, kV	Basic Insulation Level, kV	Preferred Nominal System Voltage, kV	Test Voltage for Potential Transformers, kV	Test Voltage for Current Transformers, kV	Radio Influence Voltage Level, <u>Microvolts</u>	
					Dry Type	Oil Filled
0.6	10	.....	.....	0.76	250	250

## 2.3 ENCLOSURES

### 2.3.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed in industrial locations in a NEMA Type 12 industrial use, sheet-steel enclosure, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

### 2.3.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

Contain remote-control stations installed in dry noncombustible dust-laden atmospheres in NEMA Type 12 dusttight, cast-iron enclosures with gaskets or their equivalent to prevent the entrance of dust.

Install remote-control stations with the centerline 66 inches above the finished floor.

## 2.4 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, NEMA AB 1, and NEMA AB 3.

### 2.4.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit

breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of NFPA 70 and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

#### 2.4.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and NEMA AB 1.

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed in industrial locations in NEMA Type 12, industrial-use sheet steel enclosures, constructed to prevent the entrance of dust, lint, fibers and flyings, and oil and coolant seepage.

#### 2.5 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.



Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on Equipment Drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

## 2.6 CONTROL DEVICES

### 2.6.1 Magnetic Contactors

Provide magnetic contactors in accordance with NEMA ICS 1 and NEMA ICS 2 as required for the control of low-voltage, 60-hertz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Provide contactor that is designed with a normally open holding circuit auxiliary contact for control circuits, with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

Furnish solderless pressure wire terminal connectors, or make available for line-and-load connections to contactors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide magnetic contactors with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

### 2.6.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

### 2.6.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120-volt, 60-hertz magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

### 2.6.4 Pushbuttons and Switches

#### 2.6.4.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

#### 2.6.4.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

#### 2.6.4.3 Ammeter Selector Switches

Provide rotary multistage snap-action type ammeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600-volts AC or DC. Provide a manually operated, four-position selector switch rated for 600 volts, 20 amperes, minimum, and designed to permit current readings on each bus of the main bus from a single indicating instrument. Mount ammeter switch on the hinged front panel of the switchgear compartment and completely isolate it from high-voltage circuits, with engraved escutcheon plate.

Provide a oval type selector switch handle.

#### 2.6.4.4 Voltmeter Selector Switches

Provide rotary snap-action type voltmeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600 volts AC or DC. Provide manually operated, four-position switch designed to permit voltage readings on each phase of the main bus from a single indicating instrument. Mount voltmeter switch on the hinged front panel of the switchgear compartment and completely isolate from high-voltage circuits, and with engraved escutcheon plate.

Provide a oval type selector switch handle.

#### 2.6.4.5 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

### 2.7 PROTECTIVE RELAYS

#### 2.7.1 Overcurrent Relays

Conform to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults, provide single-phase nondirectional removable induction type overcurrent relays with built-in testing facilities designed for operation on the DC or AC control circuit indicated.

Provide ground-fault overcurrent relays with short-time inverse time characteristics with adjustable current tap range as required.

Provide phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range as required, and indicating instantaneous-trip attachments with adjustable current range as required.

Semiflush-mount case with matching cover to the hinged instrument panel.

Provide solid-state static-type trips for low-voltage power circuit breakers in accordance with EIA 443 and IEEE C37.17.

Provide a trip unit that employs a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system.

Provide complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker including: overload; short circuit; and ground fault.

Wire trip unit to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground fault circuits using a small hand-held test kit.

#### 2.7.2 Undervoltage Relays

For undervoltage relays conform to IEEE C37.90.

Provide three-phase induction type undervoltage relays, including inverse timing with adjustable high- and low-voltage contacts and calibrated scale for protection against loss of voltage, undervoltage, and overvoltage. Equip relays with indicating contactor and voltage switches to provide electrically separate contact circuits. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120-volt AC circuits, with contacts that are suitable for operation on DC or AC control circuits.

Semi-flush mount case with matching cover to the hinged instrument panel.

#### 2.8 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1.

#### 2.9 INDICATING LIGHTS

##### 2.9.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with NEMA C78.23. Provide indicating lights color coded in accordance with NEMA ICS 6.

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

#### 2.10 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to SECTION 09964, PAINTING: HYDRAULIC STRUCTURES.

## PART 3 EXECUTION

## 3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to NFPA 70, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.

## 3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D 877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to NEMA C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

## SECTION 16120

## INSULATED WIRE AND CABLE

## 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 within the text by the basic designation only.

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 383	(2003) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004
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## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 70	(2009) Standard for Non-Shielded Power Cable 2000 V or Less for the Distribution of Electrical Energy
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## 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. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

## SD-03 Product Data

Manufacturer's Catalog; G  
Installation Instructions  
Cable manufacturing data.

## SD-06 Test Reports

Tests, Inspections, and Verifications  
Installation Test Report

## SD-10 Operation and Maintenance Data

Operation and Maintenance Manual

## 1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable

without splices. Reels shall remain the property of the Contractor.

#### 1.4 PROJECT/SITE CONDITIONS

Existing facility with new gate construction.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Manufacturer's Catalog

Manufacturer's catalog data comprised of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the Contract Documents. Data shall include cable-manufacturing data for each reel of cable. Standard catalog data will not be acceptable unless irrelevant parts are marked out and relevant parts are clearly identified. Identification must still be visible after black and white copying. Manufacturer's catalog data shall be in the required Operation and Maintenance Manual.

##### 2.1.2 Wire Table

Furnish wire and cable in accordance with the requirements of the Contract Documents, conforming to the detailed requirements specified herein.

##### 2.1.3 Rated Circuit Voltages

<u>Classification</u>	<u>Rated Circuit Voltage</u>
480 V and below Power Circuits	600V
Control Circuits	600V
Instrumentation	600V

All wire and cable shall have minimum rated circuit voltages in accordance with NEMA WC 70.

##### 2.1.4 Conductors

###### 2.1.4.1 Material for Conductors

Conductors shall conform to all the applicable requirements of NEMA WC 70, as applicable, and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

###### 2.1.4.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits.

###### 2.1.4.3 Stranding

Conductor stranding classes cited herein shall be as defined in NEMA WC 70, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and

moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

#### 2.1.5 Insulation

##### 2.1.5.1 Insulation Material

Provide insulation which shall be XHHW-2 cross-linked thermosetting polyethylene (XLPE) type, meeting the requirements of NEMA WC 70, as applicable.

##### 2.1.5.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

- a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by NEMA WC 70, as applicable. Some thicknesses of NEMA WC 70 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 70 ethylene-propylene rubber-insulated conductors shall have a jacket.
- b. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by NEMA WC 70, as applicable.

#### 2.1.6 Jackets

All cables shall have jackets meeting the requirements of NEMA WC 70, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

##### 2.1.6.1 Jacket Material

The jacket shall be one of the materials listed below. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

###### a. General Use

- (1) Heavy-duty black neoprene (NEMA WC 70).
- (2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 70).



(3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 70).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph "General Use," or the jackets may be of one of the following:

(1) General-purpose neoprene (NEMA WC 70).

(2) Black polyethylene (NEMA WC 70).

(3) Thermoplastic chlorinated polyethylene (NEMA WC 70).

#### 2.1.6.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by NEMA WC 70, and shall be in addition to the conductor insulation thickness required by Column B, Table 3-1, of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by NEMA WC 70.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in NEMA WC 70. If shielded, the jacket thickness shall be in accordance with the requirements of NEMA WC 70.

### 2.2 CABLE IDENTIFICATION

#### 2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with NEMA WC 70, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with NEMA WC 70. Power cable color-coding shall be in accordance with this section. Other individual conductors shall be color-coded as indicated on the Contract Drawings but such color-coding may be accomplished by applying colored plastic tapes or sleeving at terminations.

#### 2.2.2 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to NEMA WC 70, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross-section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the

cable and shall be lapped at least 10 percent of its width.

### 2.2.3 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

## 2.3 SPECIAL WIRE AND CABLE

### Instrumentation Cable

Instrumentation cable for analog signals shall be twisted shielded pair (TSP) No. 16 AWG with overall fail shield rated for 600V. Cable shall be UL listed and suitable for use in cable trays and conduits. Cable shall be constructed with flame-retardant cross-linked polyethylene (XLPE) and a low-lead hypalon chlorosulfonated polyethylene jacket with a maximum rated temperature of 90 degrees Celsius.

### CAT 6 Ethernet Cable

Communications cable for PLC racks and operator interfaces shall be four twisted pair No. 23 AWG CAT 6 cable rated for 300V. Cable shall be UL listed and constructed with flame-retardant cross-linked polyethylene (XLPE) and an industrial grade flame-retardant jacket with a maximum rated temperature of 75 degrees Celsius. Cable shall be suitable for use in conduit.

## PART 3 EXECUTION

### 3.1 INSTALLATION INSTRUCTIONS

The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

- a. Minimum Bending Radius, in Inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.
- b. Pulling tension and sidewall pressure limits, in pounds.
- c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.
- d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

### 3.2 TESTS, INSPECTIONS, AND VERIFICATIONS

#### 3.2.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be

satisfied.

### 3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the Contracting Officer or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with NEMA WC 70. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below.

#### 3.2.2.1 High-Voltage Test Source

Cables to be used exclusively on AC circuits shall be tested with AC test voltages.

#### 3.2.2.2 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE Std 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 70. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case, the reports furnished under paragraph "Reports," shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

#### 3.2.2.3 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or DC high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

#### 3.2.2.4 Reports

Furnish results of tests made. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

### 3.3 IDENTIFICATION

Power circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color-coding and circuit designation. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions. Circuit designation markers shall contain legible identifications and shall be durable and resistant to change due to age or contact with insulating materials. Wire identification shall be as

shown on the Contractor's drawings.

a. Color-coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color-coding for single-phase low voltage systems shall be as follows:

- (1) 120-Volt, 1-Phase: black (A) and red (B).

The color-coding for three-phase systems shall be as follows:

- (1) 240-Volt, 3-Phase: black (A), red (B), and blue (C).

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer (CO) or CO's Technical Representative.

### 3.4 BENDS

The minimum radius to which an insulated conductor larger than No. 8 AWG or multi-conductor cable may be bent, without specific approval, whether permanently or temporarily during installation, shall be 12 times the diameter of the outer covering. In those instances where this radius is not possible, approval will be required for minimum radii as follows:

a. Single Conductors.

<u>Insulation Thickness</u> <u>in Mils</u>	<u>Minimum Bending</u> <u>Radius in Multiples</u> <u>of Overall Diameter</u>
125 and over	8

b. Multi-Conductors. Manufacturer's recommendation and approval by the Contracting Officer's Technical Representative is required.

### 3.5 PULLING WIRE AND CABLE

Each wire and cable shall be connected to the associated equipment at both ends and shall be continuous and without splices between terminating points. Wire and cable shall be installed without damage to the insulation or jacket. Pulling stresses in the cable or conductor shall not exceed the following values:

a. When the pulling force is applied directly to the conductor (i.e., when pulling eyes are used or when the conductor is formed into a loop), it shall be limited to .008 pounds per circular mil area of cross section for copper conductors.

b. When a grip is applied over non-metallic sheathed cables, the pulling force shall be limited to 1,000 pounds, provided this is not in

excess of the force calculated in (1) above.

c. To limit the sidewall pressure at bends in duct and conduit runs, the pulling force in pounds shall not exceed 100 times the radius of the bend in feet.

d. Strain gauges shall be used on any pull where the above values might be approached or exceeded. Any cable or conductor damaged during installation shall be removed and replaced with equivalent cable or conductor. Installation of wire and cable shall include all supporting devices and all terminations required to complete the circuits. Vertical conduits terminating in floors or bottoms of boxes or equipment shall have fiber washers, drilled to fit the wire or cable, installed under each conduit bushing. Bushings shall be provided where required for cable passage and shall be of the insulating type. Cable pulling sheaves of adequate size shall be used where necessary to prevent damage to the cable.

### 3.6 INSTALLATION TEST REPORT

Contractor shall submit copies of cable installation test report to Contracting Officer's Representative or COR's Technical Representative.

### 3.7 SPLICES

Splices in power and control conductors will not be permitted unless specifically shown on the drawings.

### 3.8 EXPOSED WIRING

Individual conductors and groups of conductors shall be clamped in position. Groups of wires shall be placed into conduit or wire trough and supported as required to provide a neat installation.

### 3.9 TERMINATION

Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall not be broken and twisted around the terminal. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited.

### 3.10 FIELD TESTING

#### 3.10.1 General

Field testing shall be performed in the presence of the GQAR. The Contractor shall notify the Contracting Officer's Representative 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer's Representative or the COR's Technical Representative. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field and installation test reports shall be signed and dated by the Contractor.

### 3.10.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

### 3.10.3 Wire Test

After installation, but prior to final terminal connection, each conductor shall be tested as follows:

- a. 1,000 V "Megger" test of conductors rated 600V and 1,000V with all other conductors in each conduit or cable grounded. The final insulation resistance of all conductors rated at 600 and 1,000 volts shall be at least 1,000,000 ohms minimum.
- b. Continuity test of each conductor from terminal to terminal and phase identification check of power conductors shall be performed.
- c. Suitable records shall be kept of all tests, indication of the "Megger" readings, continuity test, and conductor identification markings. A duplicate record of all tests shall be submitted. Any length of wire or cable failing under the above tests shall be replaced. Tests shall be witnessed by a GQAR. Prior to testing submit the proposed test record form for approval.

### 3.11 STORING AND HANDLING

Cables on reels and wire in coils shall be stored in an area reserved for that purpose and protected from damage. Reels shall be stored with the axis hole on the horizontal plane. Cables on reels stored laying flat on the side of the reel will not be accepted. Reels shall be rolled only in the direction indicated by the manufacturer. Conductors shall be unreeled or uncoiled slowly to prevent damage to the sheath by sudden bending. Unreeling or uncoiling shall be stopped if kinks appear and shall not proceed until kinks have been removed. Kinked or improperly handled cable may be rejected.

### 3.12 OPERATION AND MAINTENANCE MANUAL

Complete operating and maintenance data regarding wire and cable shall be submitted as part of the O&M Manual. The manual shall include the manufacturer's name, part number and catalog cut sheets. For additional requirements, see SECTION 01781, OPERATION AND MAINTENANCE MANUAL.

-- End of Section --

## SECTION 16405

## PROCESS CONTROL PANELS AND HARDWARE

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA TIA/EIA-568-B.2 (2001) Commercial Building  
Telecommunications Cabling Standard - Part  
2: Balanced Twisted Pair Cabling  
Components (ANSI/TIA/EIA-568-B.2)

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000; R 2005; R 2008) Standard for  
Industrial Control and Systems General  
Requirements

NEMA ICS 1.1 (1984; R 2003) Safety Guidelines for the  
Application, Installation, and Maintenance  
of Solid State Control

NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for  
Controllers, Contactors, and Overload  
Relays Rated 600 V

NEMA ICS 6 (1993; R 2001; R 2006) Standard for  
Enclosures

NEMA 250 (2008) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

## UNDERWRITERS LABORATORIES (UL)

UL 50 (2007) Enclosures for Electrical  
Equipment, Non-environmental Considerations

## 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

Terminal and Wire Designations; G

SD-02 Shop Drawings

## Shop Test Plan; G

Test plan shall be submitted 14 days prior to conducting tests.

## Shop Drawings; G

Shop drawings shall be submitted 30 days after the award of the Contract.

## Nameplates

## As-Shipped Drawings; G

## As Constructed Drawings; G

## SD-03 Product Data

## Pilot Devices, G

## Manufacturer's Catalog Data, G

## Material and Equipment List, G

Material and Equipment List shall be submitted 15 day after the award of the Contract.

## SD-06 Test Reports

## Shop Test Report; G

Test report shall be submitted 15 days after completion of testing.

## SD-08 Manufacturer's Instructions

## Installation Procedures; G

## SD-10 Operation and Maintenance Data

The following information shall be included in the Operations and Maintenance Manual:

- a. Manufacturer's operating and maintenance manuals for each device or item provided.
- b. Recommended spare parts stocking list.
- c. As-Constructed Drawings of completed control panels.
- d. Detailed high resolution digital photos on CD-ROM of each installed control panel (minimum of 20 photos per panel).

## 1.3 QUALITY ASSURANCE

A. Control panels supplied under this section shall be provided by a single manufacturer.

B. Provide control panels bearing the label of a testing laboratory recognized in the USA.



C. Submit and obtain approval of shop drawings.

D. Prior to shipment to the project site, test completed control panels in panel fabricators shop as specified in paragraph 3.3 "SHOP TEST."

#### 1.4 STORAGE AND HANDLING

A. After completion of shop assembly and testing, enclose panels in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture. Place dehumidifiers inside the polyethylene covering.

B. Skid-mount the equipment for final transport to the electrical building final assembly site. Show shipping weight on shipping tags, together with instructions for unloading, transporting, storing, and handling on job site.

#### 1.5 NAMEPLATES

Provide laminated plastic nameplates for each control panel, pushbutton, switch, pilot light, electronic display, terminal block, PLC rack and relay switch; as specified in the technical sections or as indicated on the Contract Drawings. Each nametag shall indicate the type or function and specific unit number as indicated shall permanently mark major items of electrical equipment. Additional nameplate requirements shall be as per SECTION 16051, COMMON WORK RESULTS FOR ELECTRICAL.

#### 1.6 COORDINATION

The drawings indicate the extent and the general location and arrangement of equipment and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the equipment shall be properly located and readily accessible. Panels and other equipment and materials shall be located to avoid interference with mechanical or structural features. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

#### 1.7 SHOP DRAWINGS

Shop drawings shall be dimensioned, to-scale and show:

- a. Panel layout.
- b. Arrangement, connection and interconnection of PLC system components.
- c. Wire trough.
- d. Wiring access locations.
- e. Elementary wiring diagrams.
- f. Terminal block drawings, differentiating between panel and field wiring.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Manufacturer's Catalog Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the Contract Documents. Standard catalog data will not be acceptable unless irrelevant parts are marked out and relevant parts are clearly identified. Identification must still be visible after black and white copying.

### 2.2 MATERIALS AND EQUIPMENT

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer complete with make and model of each item. Materials and equipment shall conform to the respective publications and other requirements specified below and in the material and equipment list. Materials and equipment not listed below shall be as specified elsewhere in this section.

### 2.3 MATERIALS

#### 2.3.1 Enclosures

##### 2.3.1.1 General

All cabinets, boxes and enclosures shall conform to NEMA ICS 6 of NEMA 250 unless otherwise specified. Cabinets, boxes, and enclosures with volume greater than 100 cubic inches shall be in accordance with UL 50. The NEMA 250 type of enclosure and the material are specified on the Contract Drawings. Should the type and material not be indicated then all outdoor enclosures and indoor enclosures shall be NEMA 250 Type 12, galvanized steel.

Operator Panel Enclosures shall be factory UL labeled enclosures fabricated into a rigid self-supporting structure.

##### 2.3.1.2 Metallic Enclosures

Galvanized Steel. Hot-dip galvanizing shall be performed after fabrication. Galvanization damaged during installation or drilling shall be repaired with galvanizing repair compound. Sheet steel shall be not lighter than No. 12 U.S. Standard gauge. Screw-tight or welded hubs shall be provided at conduit entrances. Knockouts will not be permitted, with the exception of NEMA Types 1 and 3. Drilling in the field will only be permitted with specific approval. Cabinets shall be furnished with doors, gaskets and trim.

##### 2.3.1.3 Doors, Covers, Trim and Hardware

Each door shall be equipped with flush or semi-concealed hinges. The hinges shall be continuous and constructed from heavy gauge steel. Identifying nameplates as specified in paragraph 1.5 "NAMEPLATES," shall be provided on the front of the doors with designations as shown on the Contract Drawings. Boxes shall be furnished with covers of the same material and gauge metal as the box. Cover fastening latches shall be placed not more than 12 inches apart along the perimeter of a box. No box shall have less than four cover fastening latches.

## 2.4 COMPONENTS

### 2.4.1 General

Control accessories shall be provided and shall be suitable for mounting on the front of, or inside, the cabinet as indicated. Control accessories shall meet the applicable requirements of NEMA ICS 2. All wiring for external control circuits shall be wired to adjacent terminal points as shown on the Contract Drawings. All control push buttons, selector indicator lights, and electronic displays shall be installed with nameplates.

### 2.4.2 Fused Terminal Blocks

Fused terminal blocks shall be of the same manufacturer as the regular terminal blocks and be pull out type with indicator. Fuses shall be supplied for all fused terminal blocks and rated for 150 VAC with a maximum size of 10 Amps.

### 2.4.3 Pilot Devices

Pilot devices (control units and stations) shall be heavy-duty, oil-tight, and shall be manufactured by type per NEMA ICS 1, pilot lights push to test transformer type. Shall be as shown on the Contract Drawings or approved equal.

A. Control Switches. Control station switches shall be of the panel mounted, heavy duty, oil-tight construction with double break silver contacts. Contacts shall have the rating designation of A600 in accordance with Table 2-125-1 of NEMA ICS 2. The type of switch furnished shall be determined by the contact arrangement or as indicated. Each control switch escutcheon plate shall be clearly marked to show each operating position. Switch identification numbers shall be engraved on the escutcheon plates or on separate nameplates. The escutcheon and nameplate markings shall be as shown. Control switches shall be as shown on the Contract Drawings or approved equal.

B. Pushbuttons. Pushbuttons shall be of the oil-tight type, to NEMA ICS 2 standards. Where applicable, in enclosures rated NEMA 4X, they shall be to NEMA 4 requirements. Each pushbutton shall have an individual nameplate, furnished by the manufacturer, with the pushbutton function clearly indicated. All functions shall be as indicated on the drawings. Contacts, rated for NEMA A600, rated at 24 volts DC, for 10 amps continuous current and with a "make" current of 60 amps and a "break" current of 6 amps shall be furnished to perform the function intended and as shown on the Drawings. Contact blocks shall be of the oil-tight type. All push button operators that are exposed to the weather shall be installed with weather resistant boots. Pushbuttons shall be as shown on the Contract Drawings or approved equal.

C. Indicating Lights. Indicating lights shall be 30 mm, corrosion resistant NEMA 250 Type 4, 24 volts DC. Lights shall be 7-element LED cluster type, push to test, and be complete with color caps as indicated. Lights shall be as shown on the Contract Drawings or approved equal.

#### 2.4.3.1 Terminals

A. Terminal Blocks. Terminal blocks for the control circuits shall be of

the modular DIN rail type, NEMA rated, minimum 22A at 600 VAC. Terminals shall be tubular screw type and must be able to accept at least one No. 10 AWG wire. Feed-through terminals shall be provided with isolating knife disconnect switch. Not less than 20-percent spare terminals shall be provided on each block or group of blocks. The minimum number of spare terminals shall be four. Terminal blocks shall be as shown on the Contract Drawings or approved equal.

B. Marking Strips. Marking strips of white or other light colored plastic, fastened by screws to each terminal block, shall be provided for wire designations. Wire numbers shall be shown for each connected terminal on the marking strips with permanent marking fluid. The marking strips shall be reversible to permit marking both sides.

C. Terminal and Wire Designations. Each device to which a connection is made shall be assigned a device designation in conformance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the schematic and connection diagrams. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit each external individual conductor entering to be terminated on adjacent terminal points. THE WIRE (TERMINAL POINT) DESIGNATIONS USED ON THE CONTRACT DRAWINGS ARE FOR CLARIFICATION PURPOSES ONLY. A LIST OF PERMANENT DESIGNATIONS SHALL BE PREPARED BY THE CONTRACTOR AND PROVIDED TO THE GOVERNMENT FOR APPROVAL. Prints of drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required. The wiring diagram or connection diagram shall be in a form showing the physical arrangement of the controls showing interconnecting wiring by lines or indicating interconnecting wiring only by terminal designation and an address system. Tube type markers shall be sized to snugly fit the wire being marked. Markers shall contain legible identifications and shall be durable and resistant to change due to age or contact with insulating materials. Wire identification shall be as shown on the Contract Drawings.

#### 2.4.3.2 Power Supplies

Power supplies shall be 120 VAC input, 24 VDC output. Power supplies shall be as shown on the Contract Drawings or approved equal.

#### 2.4.3.3 Ethernet Switch

An Ethernet switch shall be used to connect the new and existing PLC racks and HMI computer terminal together. The switch shall support both 10Mbps and 100Mbps Fast Ethernet in either half or full duplex modes. The switch shall be supplied with RJ45 Ethernet ports. The switch shall be DIN-rail mountable, operate on 240 VDC, and be mechanically and electrically compatible with the system. The Ethernet switch shall be as listed in the Contract Drawings or approved equal.

#### 2.4.3.4 Cat 6 Copper Patch Cables

A. Pre-manufactured (factory-terminated), stranded unshielded twisted pair (UTP), with 8-pin modular plugs and/or termination block-style patch plugs

B. Category 6: Shall exceed Category 6 transmission as specified in EIA TIA/EIA-568-B.2 and IEC 60603-7-4. Modular plugs shall be complete with snagless boots: AMP #219886-6 or approved equal.

C. For additional cable requirements, see SECTION 16120, INSULATED WIRE AND CABLE.

## 2.5 PROGRAMMABLE LOGIC CONTROLLER

Refer to SECTION 16406, PROGRAMMABLE LOGIC CONTROLLER HARDWARE.

## 2.6 FABRICATION

### A. Wall mounted panels.

- (1) Welded construction.
- (2) Completely enclosed, self-supporting, and gasketed dust-tight.
- (3) Seams and corners welded and ground smooth.
- (4) Full length piano hinges rated for 1.5 times the weight of the door and door mounted instruments.
- (5) Doors with keyed alike locking handles and three point catch.
- (6) Each panel with lifting eyebolts. Furnish stainless steel base channels.
- (7) Slotted bolt holes in the base, 1 1/2 inches long for field adjustment.

### B. Panel Wiring.

- (1) All control wire within control panels shall be stranded copper wire (type XHHW-2) with 600V insulation.
- (2) Line voltage color coding of insulation shall be: black for power, white for 120V neutrals, red for AC controls which derive their source from within the panel, yellow for AC controls which derive their source external to the panel, blue for low voltage DC controls, green for grounding conductors.
- (3) Instrumentation wiring for DC analog circuits shall be stranded No. 16 AWG, minimum size copper conductor with FEP conductor insulation with foil or stranded wire shielding and overall Gray FEP jacket.
- (4) Shop or factory wire panels to identified terminal blocks equipped with screw type lugs. Wire trough shall be as shown on the Contract Drawings or approved equal. Wire trough shall be constructed of non-metallic materials with a voltage insulation in excess of the maximum voltage carried therein. Wire trough to be as shown on the Contract Drawings or approved equal.

## 2.7 SPARE PARTS

The following parts shall be furnished as spares:

- a. One (1) - Control relay of each type and rating.
- b. Five (5) - Fuses of each type and rating for each panel.

c. Twenty-five (25) - Terminal blocks of each type.

Any other spare parts identified in the Contract Drawings shall also be furnished.

### PART 3 EXECUTION

#### 3.1 INSTALLATION PROCEDURES

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

#### 3.2 DESIGN AND FABRICATION

##### 3.2.1 General

- A. Provide panels as indicated on the Contract Drawings.
- B. Control panels shall be factory or shop fabricated units completely assembled, wired and tested before shipment to the job site.
- C. Panel construction, in general, shall meet applicable NEMA and IEEE standards.
- D. The panels shall be constructed in accordance with electrical testing laboratory standards and shall be so labeled (to the standards of a recognized electrical testing laboratory).
- E. Size panels sufficient for the enclosed equipment and the available wall space for mounting of the panel, but not smaller than as shown on the Contract Drawings.
- F. Panels shall be descaled, cleaned and primed in preparation for painting. Painting shall consist of one coat of flat white enamel in the interior and powder coat for the exterior. Paint shall be suitable for field touch-up.

##### 3.2.2 Fused Terminal Blocks

Label all fused terminal blocks with fuse identification number and fuse size and type. Provide ten spare fuses of each type and size in each panel. Provide box mounted on panel interior marked "SPARE FUSES" to hold the spares.

##### 3.2.3 Panel Nameplates and Identification

- A. Identify each item on the control panel with rectangular nameplates.
- B. Nameplates shall be as specified in paragraph 1.5 "NAMEPLATES."
- C. Abbreviations are not permitted unless approved by the GQAR or specifically shown on the nameplates, schedules, or drawings.
- D. Install nameplates plumb and parallel to the lines of doors or structure to which they are attached.

E. Enclosure nameplates shall be fastened with approved metal fasteners. A permanently embossed and attached tag shall identify all wiring (no hand written tags).

#### 3.2.4 Component Installation

A. Minimize welding to panel fronts and avoid distortion of panel metal.

B. Reinforce around areas of the enclosure weakened by openings or mounting of heavy equipment/components.

C. Accurately and cleanly cut or nibble cut-outs, and finish free of sharp edges or burrs. Make cutouts plumb, level, and on-line vertically or horizontally within 1/32 of an inch where components are in rows or columns.

D. Provide minimum 1 5/8 inches spacing between horizontal rows of externally mounted components; 1 1/2 inches minimum between vertical columns of components.

E. The distance from the bottom row of components to the floor shall be not less than 36 inches, unless specifically shown as less. In general, all indicating lights, pushbuttons, and similar control devices, shall be mounted in accordance with the sequence of operation from left to right and top to bottom.

F. Provide minimum 1/4-inch spacing between components mounted on the panel sub-plate. Provide minimum spacing between the component and the wire duct of 1 1/2 inches above and one inch below. Provide additional space if required to access terminals, adjusting screws, and similar items.

G. Components mounted in the interior shall be fastened to an interior subpanel using machine screws.

H. Interior component mounting and wiring shall be grouped as much as possible by function and then by component type. Interiors shall be so arranged that control relays, terminal blocks, fuses, etc., can be replaced or added without disturbing adjacent components.

I. Provide wire troughs for panel wiring.

(1) Size wire troughs per the requirements of the NEC.

(2) Provide wire troughs between each row of components, and adjacent to each terminal strip.

J. Provide wire bending space per NEMA ICS 6.

K. Label wiring within the panel with wire numbers and run in wiring duct neatly tied and bundled with tie wraps or similar materials. Identify each wire termination, including all jumpers, with machine printed non-metallic tube type markers that float on the wire at each termination. Arrange wire labels to permit reading of identification when installed. For additional requirements see SECTION 16120, INSULATED WIRE AND CABLE.

L. Connect wiring internal to the panel to the "inside" of the terminal strip. Connect field wiring to the "outside" of the terminal strip. Wires to enclosure door mounted components are considered as internal wires. Connect no more than two wires to any one control terminal point. Provide

terminal jumpers where more than two wires terminate at the same point.

M. Arrange wiring inside the panel to separate low voltage control signals of the milliamp-millivolt or other low-energy type from inductive power circuits.

N. Connect grounds and shields of circuits which derive power internal to the panel to a panel common ground bus which shall be grounded by the Electrical Contractor in the field.

O. Physically separate signals entering controllers for amplification as control outputs from all line voltage wiring and shield with continuous foil shielding or enclose them in metal raceway.

P. Provide necessary power supplies for control equipment.

Q. Provide a minimum of two inches between terminal strips and wire troughs or between terminal strips.

R. Termination requirements:

(1) Terminate panel wiring on device or terminal block screw terminals using ring-tongue insulated crimp (compression) terminators. Stranded conductors shall not be terminated bare to terminals or devices.

(2) Provide terminal strips for the termination of panel wiring not directly connected to panel mounted devices.

(3) Label each I/O terminal to indicate tag number of the conductor and connected device. Locate terminals for termination of multiconductor shielded cables adjacent to each other to minimize lengths of unshielded conductor at the terminations.

(4) Provide terminals for individual termination of each signal shield. Locate the terminal adjacent to the terminals for the signal conductors.

(5) Shielded cables used for analog signals shall be terminated with not greater than 1 inch of conductor left outside the shield. This applies to field wires entering the panel for termination, and to panel conductors. Conductor twist shall be maintained over the unshielded length to as close as possible to the point of termination. Where the overall jacket is cut back to expose the individual conductors, provide a heat shrink sleeve over the jacket, the signal, and the shield (drain) conductors. Insulate the shield (drain) conductor where not covered by the jacket or the sleeve. Where shield (drain) conductors are not terminated, cut the conductor even with the jacket so that it is covered by the sleeve to prevent inadvertent contact with other devices, terminals, or conductors in the panel.

(6) Terminate All PLC discrete and analog I/O on terminal blocks as shown on the Contract Drawings.

### 3.2.5 Panel Lighting and Power

A. Provide at least one hospital-grade convenience electrical outlet.

B. Provide one fluorescent light fixture with switch in panels 30 inches wide and larger.



### 3.3 SHOP TEST

#### 3.3.1 General

Shop-testing shall be performed in the presence of the Government Quality Assurance Representative in accordance with the shop test plan. The Contractor shall notify the Contracting Officer or the Contracting Officer's Technical Representative 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Government Quality Assurance Representative. The Contractor shall maintain a written record of all tests that includes date, test performed, personnel involved, devices tested, serial number, name of test equipment and test results. All test reports will be signed and dated by the Contractor. All testing shall be performed at the Panel Fabricator's shop.

#### 3.3.2 Shop Test Plan

Provide a shop test plan 14 days prior to conducting tests. Coordinate the panel testing schedule with the Construction Schedule. As a minimum, the test plan shall include procedures and test sheets for the following:

- a. Simulate input signals, both discrete and analog, to verify operation of control and monitoring circuits.
- b. Controllers, circuits and interlocks shall be rung out and tested to ensure that they function correctly before the panel is shipped. Each device and control loop shall be tested and demonstrated to function properly in each mode (such as "manual" and "automatic"). Discrete input signals shall be tested in both the "on" and "off" state. Analog input signals (4-20 mA and 0-10 VDC) shall each be tested at not less than three values (4.08 mA or 0.5 percent, 12 mA or 50 percent, and 19.92 mA or 99.5 percent).
- c. Correct, replace, or repair panel wiring, and/or components until testing demonstrates proper operation. Do not ship panels to the site until testing has demonstrated satisfactory operation of the panels.
- d. Attention of the Contractor is directed to the fact that more than one shop test and/or review of the panel wiring/drawings may be required. If the first shop test is not satisfactory, or results in the need to make revisions to the panel and/or 'as-shipped' drawings that cannot be effected during the course of the shop test, then a repeat shop test and/or review of the drawings against the construction will be required. The presence of the Owner's Representative at up to two shop tests/reviews will be without cost to the Contractor. If more than two shop tests/reviews are required, then the Contractor shall be required to reimburse the Owner for the Owner's Representative costs for the third and each subsequent shop test/review.

#### 3.3.3 Shop Test Report

The Contractors written records of testing shall be submitted in the form of a formal shop test reports. Test report shall be submitted 15 days after completion of field testing.

### 3.3.4 As-Shipped Drawings

Provide updated and complete as-shipped drawings at the time of final testing. The Owner's Representative shall review the drawings against the panel construction at the time of final testing. Drawings which do not reflect the actual construction of the panel will need to be revised and reviewed again by the Owner's Representative against the actual construction prior to shipment of the panel to the job site. 'As-shipped' drawings which require revisions shall be submitted to the Owner's Representative for review prior to the actual field review of these drawings against the panel construction. This process of revision and review of the drawings will be repeated as necessary to produce drawings which reflect the actual construction of the panel at the time of shipment. Do not ship panels to the site until the 'as-shipped' drawings are updated, complete, and reflect the actual 'as-shipped' status of the panel.

### 3.3.5 As Constructed Drawings

Revise all drawings upon completion of the work to show "as-constructed" status of the panel at time of project acceptance.

## 3.4 ON SITE INSTALLATION

- A. Install wall or stanchion mounted panels level and plumb.
- B. For Seismic Protection see SECTION 16070, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.
- C. Conform to NEMA ICS 1.1 for installation and application of the PLC system.
- D. Install PLC control system in accordance with manufacturer's recommendations and instructions.

## 3.5 FIELD WIRING

Field wiring shall be terminated in accordance with the requirements of paragraph 3.2.4(R) in this specification section.

-- End of Section --

## SECTION 16406

## PROGRAMMABLE LOGIC CONTROLLER HARDWARE

## PART 1 GENERAL

## 1.1 REFERENCES

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

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90.1 (2002; Errata 2003; Errata 2004) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements

NEMA ICS 1.1 (1984; R 2003) Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control

NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 3 (2005) Standard for Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC

NEMA ICS 6 (1993; R 2001; R 2006) Standard for Enclosures

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 (2008) Radio Frequency Devices

## 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

## Field Test Plan, G

Field test plan shall be submitted at least 14 calendar days prior to the start of testing. Testing shall be completed at

least 30 calendar days prior to the end of the IWWP to allow sufficient time for the government to program the system.

SD-02 Shop Drawings

Schedule of System I/O, G

SD-03 Product Data

Manufacturer's Catalog Data, G

Material and Equipment List, G

Material and Equipment List shall be submitted 15 day after the award of the Contract.

SD-06 Test Reports

Field Test Report, G

The final performance verification test report shall be delivered 15 days after completion of testing.

SD-08 Manufacturer's Instructions

Installation Procedures

SD-10 Operation and Maintenance Data

The following information shall be included in the Operations and Maintenance Manual:

- a. Manufacturer's operating and maintenance manuals for each device or item provided.
- b. Recommended spare parts stocking list
- c. Final schedule of system I/O

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

The system shall include racks, central processing units (CPU), input/output (I/O) modules, communication models, operator interfaces, power supplies, and associated accessory items to provide complete and functional control system for the Robles Diversion Dam Modification Project.

1.3.2 Performance Requirements

The installed system shall perform the functional and operational algorithms required for control of the process. A Field Test Plan showing when and how each system will be tested, material testing, and certification records, shall be submitted for approval at least 14 calendar days prior to the start of testing.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Manufacturer's Catalog Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the Contract Documents. Standard catalog data will not be acceptable unless irrelevant parts are marked out and relevant parts are clearly identified. Identification must still be visible after black and white copying.

### 2.2 MATERIALS AND EQUIPMENT

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer complete with make and model of each item. Materials and equipment shall conform to the respective publications and other requirements specified below and in the material and equipment list. Materials and equipment not listed below shall be as specified elsewhere in this section.

### 2.3 EQUIPMENT

- A. Conform to NEMA ICS 1.1 for installation and application of the PLC system.
- B. The equipment shall consist of fully integrated microprocessor units specifically designed for operation in unconditioned audible noise and high vibration areas.
- C. The equipment shall include analog, digital, and communication interfaces for interface directly with Ethernet/IP and communications equipment without the need for intervening conditioning devices.
- D. The equipment shall not require cooling fans or other heating or conditioning equipment to operate within this environmental range.

### 2.4 PROGRAMMABLE LOGIC CONTROLLER (PLC)

#### 2.4.1 PLC General Requirements

- A. PLC shall be micro-processor based, capable of receiving discrete and analog inputs and, through programming, shall be able to control discrete and analog output functions, perform data handling operations and communicate with external devices. PLC shall meet the requirements of Class A computing devices, and shall be labeled as set forth in 47 CFR 15 and shall be able to withstand conducted susceptibility test as outlined in NEMA ICS 1, NEMA ICS 2, NEMA ICS 3, and IEEE C37.90.1. PLC shall function properly at temperatures between 32 and 140 degrees F at 5- to 95-percent relative humidity non-condensing and shall tolerate storage temperatures between minus 40 and plus 180 degrees F at 5- to 95-percent relative humidity non-condensing.
- B. PLC shall be based on a modular, field expandable design allowing the system to be tailored to the process control application. The system shall be expandable through the use of additional hardware and/or user software. As a minimum, the PLC shall include a mounting backplane, power supply module, central processing unit (CPU) module, communications modules, and input/output (I/O) modules. The modules shall be grouped together in a

mounting rack or cabinet. The mounting rack backplane shall provide the communications mechanism to fully integrate the individual modules located within the rack. Modules shall plug directly into the backplane. The use of wire connectors between modules will not be allowed. The rack size shall be as needed to hold the equipment necessary while performing the required control functions. The system configuration shall allow for the removal and/or installation of modules under power.

#### 2.4.2 PLC System Central Processor Unit (CPU)

The CPU modules shall be self contained, microprocessor based units that provides time of day, scanning, application (ladder rung logic) program execution, storage of application programs, storage of numerical values related to the application process and logic, I/O bus traffic control, peripheral and external device communications and self diagnostics. The CPU modules shall be equipped with a minimum of 8,196K of user memory. The CPU module shall allow programming of the PLC to be done locally through the use of a laptop computer and use the manufacturer's standard Ethernet 10Base-T architecture to communicate with operator interfaces and other PLC's. Shall be as shown on the Contract Drawings or approved equal.

#### 2.4.3 Input/Output (I/O) Modules

##### A. Schedule of System I/O.

Schedule of system I/O shall include the following data: I/O point, with name, tag number, and indication of type and the characteristics of the I/O signal.

##### B. General Requirements.

Modules shall be self contained, microprocessor based units that provide an interface to field devices. The module shall be located in the same mounting rack as the other PLC components. The unit shall plug directly into the backplane of the mounting rack. Each module shall contain visual indication to display the on-off status of individual inputs or outputs. Each module shall include:

- (1) Solid-State design with status light for each channel and module failure.
- (2) Electrical isolation between logic and field device.
- (3) Power distributed through rack chassis.
- (4) Capable to withstand 1,500-volt common mode transient power surges.
- (5) Meet or exceed electrical noise tests in NEMA ICS 1.

##### C. Input/Output Characteristics

Each controller shall allow for analog input, analog output, discrete input and discrete output. The number and type of inputs and outputs for the system shall be as shown on the Contract Drawings and shall comply with the sequence of control. The system capacity shall include a minimum of 20-percent spare input and output points (no less than two points) for each point type provided. During normal operation, a malfunction in any input/output channel shall affect the operation of that channel only and shall not affect the operation of the CPU or any

other channel. Analog input circuits shall be available in 4-20 mA. Discrete input circuits shall be available in 120 VAC and 24 VDC. All input circuits shall have a minimum optical isolation of 1,500 VRMS and shall be filtered to guard against high voltage transients from the externally connected devices. Analog output circuits shall be available in 4-20mA. Discrete output circuits shall be available in 120 VAC and 24 VDC. All output circuits shall have a minimum optical isolation of 1,500 VRMS and shall be filtered to guard against high voltage transients from the externally connected devices.

D. Discrete I/O Modules.

(1) Input Modules. Discrete input modules shall be 24 VDC and have individually isolated inputs. Module shall have a minimum of 16 inputs per module. Shall be as shown on the Contract Drawings or approved equal.

(2) Output Modules. Discrete output modules shall be 24 VDC, individually isolated, digital contact output modules. Module shall have a minimum of 16 outputs per module. Shall be as shown on the Contract Drawings or approved equal.

E. Analog I/O Module.

(1) Inputs. Each channel shall be independently configurable for current (4-20ma) or voltage (0-10/5 VDC) inputs. Module shall have a minimum of 4 inputs.

(2) Outputs. Each channel shall be independently configurable for current (4-20ma) or voltage (2-10 VDC) outputs. Module shall have a minimum of 4 isolated outputs.

Shall be as shown on the Contract Drawings or approved equal.

F. Racks (Chassis). Chassis shall be capable of holding the required number of modules for proper operation of the system plus 2 spare slots where practical. Shall be as shown on the Contract Drawings or approved equal.

G. Removable Terminal Blocks (RTB) and Extended Housing. RTBs shall have screw-clamps and shall be as shown on the Contract Drawings or approved equal.

H. Accuracy. Controllers shall have an accuracy of plus or minus 0.25 percent of input span.

2.4.4 Power Supply Module

One or more power supply modules shall be provided as necessary to power other modules installed in the same cabinet. Power supply modules shall mount on the side of the PLC rack. Shall be as shown on the Contract Drawings or approved equal.

a. Power supply modules shall use AC power with a nominal voltage of 120 VAC plus or minus 5 percent. The power supply module shall monitor the incoming line voltage level and shall provide over current and over voltage protection. The output of the power supply shall be 24 VDC for the PLC racks and general 24 VDC power. Power supply modules shall be capable of withstanding a power loss for a minimum of 20 milliseconds

while still remaining in operation and providing adequate power to all connected modules.

b. Power supply modules shall be provided with an indicating light which shall be lit when the module is operating properly.

#### 2.4.5 Program Storage/Memory Requirements

The CPU shall utilize the manufacturer's standard non-volatile memory for the operating system. The controller shall have electronically erasable, programmable, read only memory (EEPROM) for storage of user programs and battery backed RAM for application memory. The EEPROM shall be loaded through the use of a laptop computer. The CPU memory capacity shall be based on the system's control requirements. The memory capacity shall be sized such that, when the system is completely programmed and functional, no more than 50 percent of the memory allocated for these purposes is used.

#### 2.4.6 Diagnostics

Each PLC shall have diagnostic routines implemented in firmware. The CPU shall continuously perform self-diagnostic routines that will provide information on the configuration and status of the CPU, memory, communications and input/output. The diagnostic routines shall be regularly performed during normal system operation. A portion of the scan time of the controller shall be dedicated to performing these housekeeping functions. In addition, a more extensive diagnostic routine shall be performed at power-up and during normal system shutdown. The CPU shall log input/output and system faults in fault tables which shall be accessible for display. When a fault affects input/output or communications modules the CPU shall shut down only the hardware affected and continue operation by utilizing the healthy system components. All faults shall be annunciated at the PLC.

#### 2.4.7 Ethernet Switch

An Ethernet switch shall be used to connect the existing and new PLC racks and operator interface terminal together. The switch shall support both 10Mbps and 100Mbps Fast Ethernet in either half or full duplex modes. The switch shall be supplied with a minimum of 4 fast 10/100BaseTX RJ45 Ethernet ports. The switch shall operate on 24 VDC and be electrically compatible with the system. The Ethernet switch shall be as listed in the Contract Drawings or approved equal.

#### 2.4.8 Slot Fillers

Each vacant slot shall be fitted with a slot filler, if available.

#### 2.4.9 Incidental Materials and Equipment

Provide all incidental materials and equipment required for a complete functional and successfully operating PLC system. These items include but are not limited to:

- a. Power supplies.
- b. Wire troughs.
- c. Terminals.



- d. Relays.
- e. DIN Rail.
- f. Interconnecting devices.
- g. Wiring.
- h. Other items and appurtenances ordinarily furnished as part of a complete system.

#### 2.4.10 PLC and Operator Interface Programming Software

One fully licensed set of all required programming, testing, and monitoring, software for the PLC shall be provided, along with any cables or appurtenances necessary to connect, program, and monitor, the PLC from a laptop running the programming software. This shall include any and all software required to program the system to function as described, including any communications packages needed to program Ethernet connections, etc. One fully licensed set of all required programming, testing, and monitoring, software for the Operator Interface shall be provided, along with any cables or appurtenances necessary to connect, program, and monitor, the operator interface from a laptop running the programming software. These software packages shall include, but not be limited to, RSLogix5000Pro, and Rockwell Automation FactoryTalk View Machine Edition or Enterprise Series software, or approved equals. This software shall be fully licensed to the Government and shall be provided to the Government no later than 30 days after notice to proceed.

#### 2.5 ACCESSORIES

Provide all accessories and appurtenances required, whether indicated or not, for completely functioning PLC control systems capable of accomplishing the requirements of the Contract Drawings.

#### 2.6 SPARE PARTS

The following parts shall be furnished as spares:

- a. One (1) - Digital input module.
- b. One (1) - Digital output module.
- c. One (1) - Power supply module.

### PART 3 EXECUTION

#### 3.1 INSTALLATION PROCEDURES

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

#### 3.2 DESIGN AND FABRICATION

- A. Conform to NEMA ICS 1.1 for installation and application of the PLC

system.

B. Conforms to the requirements of SECTION 16405, PROCESS CONTROL PANELS AND HARDWARE.

C. PLC device arrangement:

(1) The PLC Systems shall be mounted in the control panels as shown on the Contract Drawings.

(2) Component placement:

(a) Comply with NEMA ICS 6 and manufacturer's recommendations for mounting, ventilation, and grounding.

(b) Locate power supplies with sufficient clearance for circulation of cooling air.

(c) Do not place CPU or I/O racks directly above the power supply.

(d) Strategically arrange devices supplied with line power (transformers, power supplies, surge suppressors, etc.) to keep power wire runs within the enclosure as short as possible.

(e) Place circulating fans or cooling equipment, if required, close to major heat generating devices.

(f) Group input/output modules by type.

(g) Where multiple trains of equipment are controlled by the PLC, distribute the assignment/arrangement of components (such as I/O modules, power supplies, etc.) so that the failure of a single component does not affect equipment on all trains. Unless otherwise indicated or required for safety reasons, group I/O points for each train on a single I/O module.

D. After purchasing and receiving the Operator Interfaces, the Contractor shall turn them over to the Government for programming. The Government shall return the Operating Interfaces back to the Contractor prior to installation once programming is complete.

### 3.3 SHOP TEST

See SECTION 16405, PROCESS CONTROL PANELS AND HARDWARE.

### 3.4 FIELD TEST

#### 3.4.1 PLC and Operator Interface Field Test

A. The Contractor shall perform a full point-to-point check for each I/O point.

1. For inputs, from the initiating device to the input card.

2. For outputs, from the output card to the connected device.

B. The Contractor shall verify Ethernet communication with each PLC rack and operator interface.

C. The Contractor shall verify operator interface functionality with the PLC I/O.

#### 3.4.2 Field Test Report

The Contractors written records of testing shall be submitted in the form of a formal test report. The test report shall be submitted 15 days after completion of field testing.

-- End of Section --

## SECTION 16410

## TRANSFER SWITCH

## 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 within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM B117 (2011) Standard Practice for Operating Salt Spray (Fog) Apparatus

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 602 (2007) Recommended Practice for Electric Systems in Health Care Facilities - White Book

IEEE C37.13 (2008; INT 1 2009) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE C37.90.1 (2002; Errata 2003; Errata 2004) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

IEEE C62.41.1 (2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

IEEE C62.41.2 (2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements

NEMA ICS 10 Part 2 (2005) AC Transfer Equipment, Part 2: Static AC Transfer Equipment

NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 4 (2010) Terminal Blocks

NEMA ICS 6 (1993; R 2001; R 2006) Standard for Enclosures

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 110	(2010; TIA 10-1) Standard for Emergency and Standby Power Systems
NFPA 70	(2011; Errata 2 2012) National Electrical Code

## U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings
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## UNDERWRITERS LABORATORIES (UL)

UL 1008	(2011) Transfer Switch Equipment
UL 1066	(2012) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

## 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-02 Shop Drawings

Equipment

SD-03 Product Data

Material  
Equipment

SD-06 Test Reports

Testing

SD-10 Operation and Maintenance Data

Instructions

## 1.3 SITE CONDITIONS

Seismic requirements shall be as specified in UFC 3-310-04 and SECTION 16070, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT. Transfer switch shall be suitable for prolonged performance under the following service conditions:

- a. Altitude: 780 feet above mean sea level.
- b. Temperature: 20 to 110 degrees F.
- c. Seismic Parameters: OBE = 0.138g, MDE = 0.633g.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Provide material and equipment which are standard products of a manufacturer regularly engaged in manufacturing the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit list of proposed equipment and material, containing a description of each separate item, and certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards. The experience use shall include applications in similar circumstances and of same design and rating as specified transfer switch. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion, reasonably convenient to the site.

### 2.2 NAMEPLATE

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

### 2.3 TRANSFER SWITCH

Transfer switch shall be manually operated and mechanically held in both operating positions. Transfer switch shall be suitable for use in standby systems described in NFPA 70. It shall be UL listed. It shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41.1, IEEE C62.41.2, IEEE 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10 Part 2, UL 1008 and UL 1066. Transfer switch shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. Transfer switch shall be rated for continuous duty at specified continuous current rating. Transfer switch shall be fully compatible and approved for use with BP/IS specified. BP/IS shall be considered part of transfer switch system. Transfer switch shall have the following characteristics:

- a. Voltage: 240 volts AC.
- b. Number of Phases: Three.
- c. Number of Wires: Four.
- d. Frequency: 60 Hz.
- e. Poles: Three switched and switched neutral.
- f. Transfer Switch WCR: Rated to withstand short-circuit current of 20,000 amperes, RMS symmetrical.
- g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.

h. Main and Neutral Contacts: Contacts shall have silver alloy composition. Neutral contacts shall have same continuous current rating as main or phase contacts.

#### 2.3.1 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 15 amperes at 120 volts shall operate when transfer switch is connected to the existing gates' loads, and two normally open and two normally closed contacts shall operate when transfer switch is connected to the new gates' loads.

#### 2.3.2 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. Transfer switch shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

#### 2.4 ENCLOSURE

Transfer switch and accessories shall be installed in wall-mounted unventilated NEMA ICS 6, Type 12, smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Door shall have suitable hinges, locking handle latch, and gasketed jamb. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 8 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from top and bottom of enclosure. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external copper conductors shown.

##### 2.4.1 Construction

Enclosure shall be constructed for ease of removal and replacement of transfer switch components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of transfer switch with BP/IS shall be constructed to protect personnel from energized BP/IS components during transfer switch maintenance.

##### 2.4.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 12 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B117,

employing a 5-percent by weight, salt solution for 24 hours.

## 2.5 TESTING

Submit a description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than 2 weeks prior to test date. Submit certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

### 2.5.1 Factory Testing

A prototype of specified transfer switch shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each transfer switch as follows:

- a. Insulation resistance test to ensure integrity and continuity of entire system.
- b. Main switch contact resistance test.
- c. Visual inspection to verify that each transfer switch is as specified.
- d. Mechanical test to verify that transfer switch sections are free of mechanical hindrances.
- e. Electrical tests to verify complete system electrical operation.

### 2.5.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Transfer switch shall be installed as shown and in accordance with approved manufacturer's instructions. Submit dimensioned plans, sections and elevations showing minimum clearances, weights, and conduit entry provisions for each transfer switch.

### 3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door. Submit 4 copies of operating and 4 copies of maintenance manuals listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide.

### 3.3 SITE TESTING

Following completion of transfer switch installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each transfer switch functions satisfactorily and as specified. Advise Contracting Officer not less than 5 working days prior to scheduled date



for site testing, and provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

- a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.
- b. Operation and settings shall be verified for specified transfer switch features, such as auxiliary contacts and supplemental features.

-- End of Section --

## SECTION 16436

## AUTOMATIC TRANSFER SWITCHES

## 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 within the text by the basic designation only.

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NEMA ICS 1 (2000; R 2005; R 2008) Standard for  
Industrial Control and Systems General  
Requirements

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical  
Code

## UNDERWRITERS LABORATORIES (UL)

UL 1008 (2011) Transfer Switch Equipment

UL 508 (1999; Rev thru Sep 2008) Standard for  
Industrial Control Equipment

## 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. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Submit connection diagrams showing the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Contacts  
Indicating Lights  
Terminal Board

Submit fabrication drawings for the following items consisting of fabrication and assembly details to be performed in the factory.

Contacts

Indicating Lights  
Terminal Board  
Enclosures  
Accessories

Submit installation drawings for automatic transfer equipment in accordance with the paragraph entitled, "INSTALLATION," of this section.

#### SD-03 Product Data

Submit Equipment and Performance Data for automatic transfer equipment in accordance with paragraph entitled, "GENERAL REQUIREMENTS," of this section.

Submit manufacturer's catalog data for the following items:

Contacts  
Indicating Lights  
Terminal Board  
Enclosures  
Accessories

#### SD-06 Test Reports

Submit test reports for Operation Tests on the automatic transfer switch in accordance with the paragraph entitled, "FIELD TESTING," of this section.

#### SD-07 Certificates

Submit Listing of Product Installations for automatic transfer switches in accordance with paragraph entitled, "INSTALLATION," of this section.

#### SD-08 Manufacturer's Instructions

Manufacturer's instructions shall include special provisions required to install equipment components and system packages for Automatic Transfer Switch. Special notices shall detail impedances, hazards and safety precautions.

### 1.3 GENERAL REQUIREMENTS

SECTION 16050, BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Equipment and Performance Data for automatic transfer equipment including life, test, system functional flows, safety features, and mechanical automated details.

### 1.4 QUALIFICATION TESTING

Provide certified independent laboratory test data for the furnished unit or an identical unit. Tests shall meet the general use requirements of UL 508, Table 22.1. Complete automatic transfer switch shall be subjected to a test as outlined in NEMA ICS 1, paragraph 109.5. One cycle of operation tests under the UL 508 test requirements shall consist of a transfer of load from the normal source to the standby source and

retransfer to the normal source. After the required number of test cycles, the temperature rise of the contacts shall not exceed 149 degrees F. Test the switch operating time and sense relay pickup and dropout times.

## PART 2 PRODUCTS

### 2.1 APPLICATION

Automatic transfer switch shall be capable of transferring the load from the normal power source to standby power source, and from an standby source to the normal power source. Locate switch where indicated. Switch shall be solenoid-operated, mechanically held, double-throw, rated for continuous duty, capable of transferring in 100 milliseconds or less, and conforming to the applicable requirements of UL 1008 and NFPA 70, Article 700, except as herein modified. Control and protective devices associated with automatic transfer switches shall be in accordance with Section 16071, LOW-VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

Automatic transfer switch shall be the three-pole type for three-phase application. Provide an additional switched neutral pole.

Automatic transfer switch shall be capable of being placed in either the normal or the standby position.

### 2.2 CONTACTS

Main contacts shall be wiping-action silver alloy that, when rated for operation at 50 amperes or greater, shall be protected against arcing. Auxiliary contacts and control transfer relay contacts shall have a minimum continuous current rating of not less than 10-amperes inductive at 120 volts AC. Provide the following auxiliary contacts:

Generator-control contacts, normally open, that close on undervoltage or loss of normal power as specified, remaining closed until transfer back to normal power.

Standby-position contacts, normally open when the switch is in the normal position, that close when the switch is in the standby position.

Normal position contacts, normally closed when the switch is in the normal position, that open when the switch is in the standby position.

Auxiliary contacts shall be two-pole.

Provide a test automatic transfer switch mounted on the enclosure front with contacts rated 10 amperes.

Provide automatic transfer switch with overlapping neutral transfer contacts in addition to the two- or three-pole main bus contacts. Normal and standby neutral shall be connected together only during the transfer and retransfer operation. They shall remain connected only until the power source contacts close/open to transfer from one source to the other. Overlapping neutral transfer contacts connection time shall not exceed 100 milliseconds.

### 2.3 INDICATING LIGHTS

Furnish Automatic transfer switch with two indicating lamps. One shall light to indicate that the switch is operating on normal power, and the

other shall light to indicate that the switch is operating on standby power. Fuse each indicating circuit.

#### 2.4 TERMINAL BOARD

Control devices, indicating lights, auxiliary contacts, and internal control devices or auxiliary switches, shall be internally wired to a common output terminal board. Wire the internal functions to facilitate remote connections or monitoring.

#### 2.5 OPERATION

Normal source voltage across phase lines shall be monitored by sensing devices. If the normal source voltage in phase drops to 90 percent or less for a timed period, the automatic transfer switch shall start the standby source and transfer the load to the standby source when voltage and frequency reach rated values or, if the standby source is on, verify voltage and frequency of the alternate source and transfer the load to the alternate source. This time period shall be field adjustable from 1 to 30 seconds. Provide a voltage and frequency sensor relay to monitor rated values on the standby side to prohibit transfer until the standby source voltage and frequency reach at least 95 percent of the required rating. Provide phase failure protection, with 65- to 70-percent drop and 92- to 95-percent voltage pickup ratings.

Furnish the automatic transfer switch with a time-delay feature, field adjustable from 2 to 30 minutes, that operates to delay automatic transfer back to normal power until the normal source voltage and frequency reach at least 95 percent of the rated voltage. However, if the standby power fails, and the normal source is again available at 90 percent of the rated voltage, the time-delay circuitry shall be bypassed, and the load immediately transferred back to the normal source. Capability shall also be provided for manual transfer in either direction. Sensing relays shall operate without contact chatter or false response during voltage variations between dropout and pickup.

#### 2.6 SELF-TEST CAPABILITY

Automatic transfer switch shall be provided with a control-circuit self-test feature that shall be capable of verifying the proper operation of the switch control circuit without moving the main contactor or causing discontinuity of service to the load. Self-test circuit shall have the following characteristics:

A key-operated switch that disconnects the main actuator and connects in its place, an indicator light. Design the key-operated switch to prevent removal of the key while the switch is in the self-test mode.

A power-failure simulator switch that removes voltage from the voltage-sensing devices so that standby power activates the test light.

#### 2.7 ENCLOSURES

Automatic transfer switch enclosures shall be solid, unventilated, code-gage 14-gage, minimum sheet metal, NEMA 250, Type 12, with manufacturer's standard finish.

## 2.8 ACCESSORIES

Automatic transfer switch shall incorporate a 24-volt solid-state, high-and low-rate charger complete with rheostat and ammeter, to maintain the engine-generator cranking batteries in a fully charged condition.

Automatic transfer switch shall incorporate an engine-generator exerciser timer to permit weekly programming of engine-generator set test runs under load.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install automatic transfer switch as indicated, and in accordance with the manufacturer's installation instructions. Wall-mounted enclosures shall be fully aligned and installed at the indicated mounting height using a minimum of six 3/8-inch bolts. Use of sheet metal screws or small machine screws is not permitted.

Submit Listing of Product Installations for automatic transfer switches showing the manufacturer has successfully manufactured automatic transfer switches of the size specified for a minimum period of 10 years. List shall include purchaser, address of installation, service organization, and date of installation.

### 3.2 FIELD TESTING

Automatic transfer switch shall be demonstrated to operate in accordance with the specification requirements in conjunction with the normal and standby power sources.

-- End of Section --

## SECTION 16445

## SWITCHGEAR AND PROTECTION DEVICES

## 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 within the text by the basic designation only.

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) National Electrical Safety Code

IEEE C37.20.1 (2002; Addenda A 2005; Addenda B 2006; R 2007) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear

IEEE Std 4 (1995; Amendment A 2001) High Voltage Testing Techniques

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Standard for Grounding and Bonding Equipment

## 1.2 SYSTEM DESCRIPTION

SECTION 16050, BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

This is a modification to an existing electrical system, changing the service voltage in accordance with the Contract documents.

Submit Certificates to verify the qualifications of the Registered Professional Electrical Engineer.

Submit Equipment and Performance Data for electrical equipment consisting of the following:

One-line diagram of electrical equipment and system.

Short-circuit calculations and a table of short-circuit fault currents at critical points in the electrical system.

Spare Parts Data.

Time/current coordination curves on 10 1/2- by 15-inch translucent tracing paper for each relay device.

Table of recommended relay settings.

Submit Equipment Foundation Data for switchgear assemblies that includes plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

### 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 reviews the submittal for the Government. Submit the following in accordance with SECTION 01330, SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Submit connection diagrams indicating the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

##### Manual Transfer Switch

Submit fabrication drawings for the following items consisting of fabrication and assembly details to be performed in the factory.

##### Manual Transfer Switch

Submit Installation Drawings for the ATS/MTS assemblies in accordance with the paragraph entitled, "INSTALLATION," of this section.

#### SD-03 Product Data

Submit Equipment and Performance Data for electrical equipment in accordance with paragraph entitled, "SYSTEM DESCRIPTION," of this section.

Submit Equipment Foundation Data for ATS/MTS assemblies in accordance with paragraph entitled, "SYSTEM DESCRIPTION," of this section.

Submit manufacturer's catalog data for the following items:

##### Manual Transfer Switch

#### SD-06 Test Reports

Submit test reports for the following tests on switchgear assemblies in accordance with the paragraphs entitled, "FIELD TESTING" and "RELAY SETTINGS AND TESTS," of this section.

##### Electrical Acceptance Tests



Current Test  
Insulation-Resistance Test  
Electrical Current and Voltage Tests  
Ratio and Polarity Tests

#### SD-07 Certificates

Submit Certificates in accordance with paragraph entitled, "SYSTEM DESCRIPTION," of this section.

#### SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the AST/MTS Assemblies including special provisions required to install equipment components and system packages. Provide special notices that detail impedances, hazards, safety precautions, and installation instructions.

#### SD-10 Operation and Maintenance Data

Submit Operation and maintenance manuals for the following equipment:

Transfer Switches

### 1.4 FACTORY TESTING

Make factory tests on transfer switch assemblies in accordance with the applicable provisions of the referenced standards that include mechanical operational tests, electrical operation and control-wiring tests, relaying and metering circuit performance tests, and dielectric tests. Conduct tests in accordance with IEEE Std 4.

### 1.5 MANUFACTURER QUALIFICATIONS

Provide material and equipment under this specification that is the standard catalog product of a manufacturer regularly engaged in the manufacture of transfer switch assemblies and their component parts and equipment. Provide equipment that is of the latest standard design for indoor service and that has been in repetitive manufacture for at least 50 units.

### 1.6 ENGINEER QUALIFICATIONS

Perform electrical power system's circuit loading requirements and analyses by a Professional Electrical Engineer registered with the National Society of Professional Engineers (NSPE). Select a Professional Engineer who has conducted electrical coordination studies and tests for not less than five projects of comparable size and complexity. Perform work by or under the direct supervision of the Registered Professional Electrical Engineer.

#### 1.6.1 Engineering Services

Select an Electrical Engineer holding a valid state license as a Professional Engineer in the jurisdiction where the project is being constructed, and who specializes in relays and coordinating systems associated with electric-power apparatus for the manufacturer of the equipment, to coordinate all circuit-interrupting devices before the substation is energized. Duties and responsibilities of the Engineer

include the following work.

#### 1.6.1.1 Preliminary Survey and System Coordination Study

Review necessary short-circuit calculations to determine the minimum and maximum values of short-circuit current for faults anywhere in the system. Review values of fault current to be expected at each protective device shown on the one-line diagrams.

Prepare one-line diagrams that indicate by means of single lines and simplified symbols the course and component devices of an electric circuit or system of circuits and their electrical characteristics.

Inspect equipment and determine the intended function of each circuit-interrupting device and the manner in which it is connected to provide a properly coordinated electrical power system under normal load and fault conditions.

Check and compare wiring diagrams furnished by the manufacturer with actual connections of the equipment to verify that each device is properly connected to perform its intended function.

#### 1.6.1.2 Time/Current Curves and Settings

Plot time/current curves on a single sheet of graph paper or electronic format for those devices that are to operate selectively in series with each other using a common current scale, with current ratings at the lowest-voltage level. Plot curves progressively as each circuit is studied, starting with the device farthest from the source. Make each curve on the graph include tolerance band and show degree of coordination with each successive device. Coordinate adjustable and nonadjustable protective devices to operate on the minimum current that permits distinguishing between fault and load current in a minimum amount of time.

Select time and current settings for the adjustable devices that operate in sequence with the nonadjustable devices to isolate a fault with a minimum of disturbance to the unfaulted portion of the system.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT STANDARDS

Submit service entrance assemblies that conform to IEEE C37.20.1.

### 2.2 ATS/MTS COMPONENTS

#### 2.2.1 Molded-Case Circuit Breakers

Provide molded-case circuit breakers that conform to Section 16071, LOW-VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

#### 2.2.2 Instruments and Instrument Transformers

Provide indicating instruments, protective relays, current and potential transformers, instrument transfer switches, and control-power transformers that conform to the applicable requirements of SECTION 16071, LOW-VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

### 2.2.3 Manual Transfer Switch

Provide the rotary snap-action type annual transfer switch with silver-plated contacts. Provide a manually operated two-position transfer switch device designed to transfer between the system loads. Provide a switch that permits the transfer of a portion of the load to the generator without a service interruption when the automatic transfer switch switches from utility to generator power.

### 2.2.4 Protective Relays and Devices

Provide protective relays and devices that comply with SECTION 16071, LOW-VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

## 2.3 MANUAL TRANSFER SWITCH

Make provision for the manual transfer of load on loss of voltage, low voltage, single phasing, reverse phase rotation of either source, and the automatic transfer of load upon restoration of normal service without a service interruption. Under normal operation, close both main secondary breakers with the main bus tie breaker open and the automatic/manual transfer control switch in the automatic position, and energize and load each source of supply.

Provide main secondary breaker compartments that include undervoltage and phase-sequence relays with adjustable time-delay between 30 and 200 cycles.

Provide auxiliary relays that automatically open the proper main secondary breaker and close the main bus tie breaker under fault conditions. Include provisions for the automatic reclosing of the main secondary breakers before opening the main bus tie breaker when normal service is restored.

Provide lockout relays that prevent automatic transfer of load from undervoltage caused by overload or transient conditions. Provide lockout relay controls that are connected into the closing circuit of the main tie breaker to prevent operation under lockout conditions and that are the hand-reset type.

Provide main bus tie breaker compartment that includes an automatic/manual transfer switch which disconnects the automatic transfer features when in the manual position. Provide main secondary and bus tie breakers that are manually inoperable when the automatic/manual transfer control switch is in the automatic position.

Provide a bypass switch to permit manual momentary paralleling of the two sources of supply in restoring normal service without interruption.

Provide main secondary and bus tie breakers that are manually operable when the automatic/manual transfer control switch is in the manual position.

Provide a contactor for the automatic transfer of control power. Provide control power transformers that capable of furnishing power through the selective contactor for the bus tie breaker, feeder breakers, compartment heaters, interior lighting, utility outlets, battery chargers, and other miscellaneous equipment.

Supply secondary switchgear assembly or assemblies from two separate sources, with each source normally carrying load as indicated. Under normal operation, close both main secondary breakers with the main bus tie

breaker open. Do not operate two sources of supply in parallel.

## 2.4 PAINTING

After fabrication, prepare and paint exposed ferrous-metal surfaces of transfer switch assemblies and component equipment. Provide standard finish by the manufacturer on assemblies and component equipment when used for most indoor installations.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Make installation conform to IEEE C2 and NFPA 70.

Provide installation that is carefully aligned, leveled, and secured to the foundation and that conforms to the manufacturer's recommendations.

Provide noncurrent carrying parts and enclosures of the transfer that are bonded together and grounded to the ground grid with a maximum resistance to ground of 20 ohms. Exothermically weld inaccessible ground connections in accordance with UL 467. The minimum size of ground conductor is 4/0 AWG.

Submit Installation Drawings for the transfer switch assembly. Provide drawings that include complete details of equipment layout and design.

### 3.2 FIELD TESTING

Perform Electrical current and voltage tests in accordance with referenced standards in this section.

Provide test equipment, labor, and technical assistance to perform the electrical acceptance tests as herein specified.

Provide tests on transfer switch assembly that include electrical and mechanical operational tests, control-wiring tests, relaying and metering circuit performance tests, and dielectric tests. Conduct tests in accordance with IEEE Std 4.

Final acceptance depends upon the satisfactory performance of the equipment under test. Provide final test data to the Contracting Officer. Provide data with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Data - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

### 3.3 RELAY SETTINGS AND TESTS

Properly coordinate circuit-interrupting devices before the switchgear assemblies are energized. Thoroughly inspect and adjust relays at the site in the presence of and at the discretion of the Contracting Officer.

### 3.4 PRELIMINARY INSPECTION

Conduct preliminary inspection of electrical equipment. Make relay settings and tests only after the preliminary survey and system coordination survey have been completed. Provide preliminary inspection, relay settings, and tests as follows:

Inspect equipment for damage or maladjustment caused by shipment or installation. Remove wedges, ties, blocks, and other packing material installed by manufacturer to prevent damage in shipment.

Verify protective relays, auxiliary relays, trip coils, trip circuit seal-in and target coils, fuses, and instrument transformers to be of the proper type and range.

Perform electrical continuity tests on current, potential, and control circuits.

Perform Ratio and polarity tests on current and potential transformers.

Perform insulation-resistance tests on relays, wiring, instrument-transformer secondary windings, and instruments.

Remove each adjustable relay from its case and calibrated separately as an instrument, using a variable alternating-current source and an accurate timing device. Verify with this procedure that the relay has not been damaged in shipment and that it performs in accordance with previously prepared time-current coordination curves at specified current tap and time dial settings.

With the relay disconnected and the main current transformer effectively open, apply a current test to the remainder of the secondary circuit to detect any open or short-circuit connections.

Reinstall and connect relays into their current-transformer secondary and control circuits.

Report any defects in electrical equipment, protective devices, wiring, or other conditions that prevent complete coordination and the successful operation of equipment to the Contracting Officer before proceeding with the work.

After the installation has been thoroughly tested and certified to be in satisfactory condition, with relays calibrated and adjusted to the proper current tap and time dial setting, request permission to energize the equipment at system voltage for final testing.

### 3.5 ENERGIZING TRANSFER SWITCH ASSEMBLY

Do not energize transfer switch assembly until it is completely installed, tested, approved by the Contracting Officer, and ready for operation. Conduct site testing and obtain approval from the Contracting Officer.

Using ammeter, voltmeter, and wattmeter or phase-angle meter, measure and compare the values and polarities of voltage and current with those expected in the various relay circuits. Inspect and note positions of directional elements and the voltage relays.

After inspection and satisfactory tests have been completed on all active relay circuits under a no-load condition, give each relay an operational test with diverted load currents or simulated ground faults.

Prepare a report with records of connections, electrical constants, settings, test values, operating performance, and failures or weaknesses found on test.

Perform tests and procedures for testing in accordance with the manufacturer's recommendations, as approved by the Contracting Officer. Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

## SECTION 16905

## ELECTRICAL EQUIPMENT FOR GATE HOIST

## 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 within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 112 (2004) Standard Test Procedure for Polyphase Induction Motors and Generators

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 (2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures

NEMA FB 1 (2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements

NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6 (1993; R 2001; R 2006) Standard for Enclosures

NEMA ST 1 (1988; R 1997) Standard for Specialty Transformers (Except General Purpose Type)

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50553 (Basic; Notice 1) Fitting for Conduit, Metal, Rigid (Thick-Wall and Thin-Wall (EMT) Type)

## 1.2 SYSTEM DESCRIPTION

All equipment furnished under these specifications will be subjected to relatively dry conditions, shall operate over a temperature range of 30 to 120 degrees F, and shall be designed to render it resistant to corrosion. The general requirements to be followed are specified below; any additional special treatment or requirement considered necessary for any individual item is specified under the respective item.

### 1.2.1 Fastenings and Fittings

Where practicable, all screws, bolts, nuts, pins, studs, springs, washers, and such other miscellaneous fastenings and fittings shall be of an approved corrosion-resisting material or shall be treated in an approved manner to render them resistant to corrosion.

### 1.2.2 Corrosion-Resisting Materials

Corrosion-resisting steel, copper, brass, bronze, copper-nickel, and nickel-copper alloys are acceptable corrosion-resisting materials. However, contact between dissimilar metals should be avoided as much as practicable, except where one of the dissimilar metals is steel or in the case of wiring and connections.

### 1.2.3 Corrosion-Resisting Treatments

Hot-dip galvanizing shall be in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as applicable. Other corrosion-resisting treatments may be used if approved by the Contracting Officer.

### 1.2.4 Frames, Enclosing Cases, and Housings

All surfaces of the enclosing cases or housings of controllers, brakes, limit switches, control stations, and other similar equipment, if other than plastic or stainless steel construction, shall be cleaned of rust, grease, mill scale, and dirt and then treated with an approved iron and zinc-phosphate solution followed by rinsing with a chromic acid solution, bonderizing, or equivalent process. Immediately after rinsing and drying, the inside and outside surfaces shall be given one coat of a zinc molybdate primer and cured as required. For items of cast construction, the iron and zinc-phosphate treatment may be omitted.

### 1.2.5 Finish Painting

A minimum of two coats of paint shall be applied to all equipment in accordance with the manufacturer's standard process for the conditions specified.

## 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



## Controller; G

Six copies of a description of the operation scheme, if other than herein specified or shown on the drawings; a dimensioned outline drawings showing specific relationships and clearances between equipment and their component parts, detailed panel layouts, schematic wiring diagrams, and a panel wiring diagram dimensioned outline drawings showing specific relationships and clearances between equipment and their component parts.

Limit Switch; G  
Encoder; G

Six copies of dimensioned outline drawing of the limit switch. Show on the Drawings specific relationships and clearances between equipment and their component parts.

Hoist Brake Motor; G  
New Control Panel; G

Six copies of dimensioned outline drawings showing specific relationships and clearances between equipment and their component parts.

## SD-03 Product Data

## Hoist Brake Motor; G

Six copies of motor characteristics, curves or tabulated data (tested or calculated), indicating the speed, power factor, efficiency, current and kilowatt input, all plotted or tabulated against torque or percent of rated motor load.

Six copies of calculations to determine the required horsepower rating of each brake motor.

Six copies of detailed descriptive specifications of the motor, with necessary cuts, photographs, and drawings to clearly indicate the construction of the machine. Place special emphasis on describing and illustrating features of "Insulated Windings," "Winding Heaters," "Bearings and Lubrication," and "Terminal Leads." Include detailed descriptive data covering the brake, with necessary cuts, photographs, and drawings to indicate clearly the construction of the brake and the materials used. Releasing device specifications and characteristics, including input current minimum voltage required for brake release.

## Limit Switch; G

Six copies of all limit switch computations used to determine the selection of gear ratios and calibration for gate travel.

Six copies of complete descriptive data covering the limit switch with necessary cuts, photographs, and drawings to indicate clearly the construction, materials used in the parts, rating, accuracy of tripping and reset, method of adjustment, and safeguards.

## Overload Relays

Six copies of curves showing the overload relay tripping time versus current characteristics of the overload relays for the controller.

#### Controller

Six copies of detailed descriptive data covering all component parts of the controller.

#### New Control Panel; G

Six copies of detailed descriptive data covering the control panel.

#### Wiring

Six copies of data sufficient to demonstrate that the proposed wire and cable conform to these specifications.

#### Conductors

##### Terminal Blocks

Method of identifying conductors, terminal leads, and terminal blocks.

#### Nameplates

Schedule of nameplates.

### SD-06 Test Reports

#### Tests

Six certified copies of the reports of all complete and routine tests, including complete test data. Certified copies of the results of a complete test for duplicate equipment will be accepted in lieu of the requirement of the complete test specified. Reports shall include analysis and interpretation of test results and shall be properly identified with the test systems and materials. Provide test reports for "complete tests" on the motor, brake, and controller. Performance curves indicating the results of the motor tests shall be furnished as follows:

a. Excitation Tests. Volts or percent of rated voltage as abscissa vs. amperes and watts as ordinates.

b. Impedance Tests. Volts or percent of rated voltage as abscissa vs. amperes and watts as ordinates.

c. Performance Test. Torque or percent of rated horsepower output as abscissa vs. efficiency, power factor, amperes watts, and rpm or percent slip as ordinates.

d. Speed-Torque Test. Torque in foot-pounds as abscissa vs. speed in rpm or percent of synchronous speed as ordinates.

e. Temperature Test. Time in minutes as abscissa vs.

temperature rise in degrees C as ordinate.

f. Insulation Resistance Test. Test result values shall be plotted on semilogarithmic graphs, the insulation resistance values as logarithmic ordinates, and the temperature values as uniform abscissa.

g. Routine test reports shall include analysis and interpretation of test results and shall be properly identified with the test systems and materials. No substitute will be accepted for the routine test. Provide test reports for "routine tests" on the motor, brake, controller, limit switch, interrupter, and wiring.

## PART 2 PRODUCTS

### 2.1 HOIST BRAKE MOTOR

#### 2.1.1 Motor Type

Refer to SECTION 14601, TAINTER GATE HOISTS for brake motor requirements.

### 2.2 CONTROL SYSTEM

The scheme of operation of the tainter gate tainter gate hoist brake motor control system shall be as described and indicated. The control system shall include the controller, limit switch, encoder, master control station, and such other items as may be required to accomplish the operating features specified. Each item shall be installed and tested as specified and shall be complete and ready for operation in accordance with the scheme of operation.

### 2.3 CONTROLLER

#### 2.3.1 Controller Type

The hoist brake motor controller shall be of the full magnetic type initiated by either the push-button control station or PLC logic and controlled automatically by both an encoder and limit switches. Limit switches shall be driven by the hoist mechanism or other auxiliary operating devices as indicated or required to provide the sequence of operation specified or indicated on the plans.

#### 2.3.2 Protection

The controller shall provide under-voltage protection, inverse-time-limit overload protection, or other protection as indicated or specified. In addition, the controller shall provide protection from single-phase faults. The protection shall be accomplished by suitable relays conforming to the requirements of paragraph "Relays." Overload relays shall provide protection during both the starting and running condition, and approved means shall be provided to manually reset the relays without opening the enclosing case of the controller. All forward and reversing contactors shall be electrically interlocked. Controller disconnecting circuit breaker shall be interlocked with the controller enclosing case access door to permit opening or closing the access door only when the disconnect is in the "OPEN" position.

### 2.3.3 Enclosure

Enclosing cabinet shall be of the NEMA Type 12 industrial use construction with interior dead-front panel meeting the requirements of NEMA ICS 6. Enclosing cabinet shall be designed for floor mounting. Suitable padlock eyes shall be provided to allow locking the exterior door in the closed position. Only front-connected devices shall be used, and clearances shall be in accordance with NEMA ICS 1 requirements. Threaded hubs for conduit entrance of the welded-in type shall be provided as indicated on the drawings or as required to make the wiring connections. Enclosure shall be supplied with a back panel for mounting all equipment.

### 2.3.4 Circuit Breakers

Circuit breakers as shown on the drawings or specified shall be provided and assembled in the housing of each controller.

#### 2.3.4.1 Circuit Breakers - General

Each circuit breaker shall conform to the applicable requirements of NEMA AB 1. The circuit breakers shall be manually operated and shall be of the instantaneous trip type, unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle and shall be enclosed in a common molded plastic case. The contacts of multi-pole breakers shall open simultaneously when the breaker is tripped manually or automatically. The operating handles shall clearly indicate whether the breakers are in "ON," "OFF," or "TRIPPED" position. Each circuit breaker shall be externally operated as specified in paragraph "Protection." Approved means shall be provided for padlocking the breaker operating handle in either the "ON" or "OFF" position. A padlock of the same type as specified in paragraph "Enclosure," shall be provided for each breaker and shall be chained to the enclosing case. The circuit breakers shall be products of only one manufacturer and shall be interchangeable when of the same frame size.

#### 2.3.4.2 Trip Units

Except as otherwise indicated on the drawings, the circuit breakers shall be provided with combination thermal and instantaneous magnetic-trip units. The minimum frame sizes and the trip-unit ratings shall also be as required for the equipment controlled. Non-adjustable instantaneous magnetic-trip unit shall be set as approximately 10 times the continuous current ratings of the circuit breakers.

#### 2.3.4.3 240-Volt AC Circuits

Air circuit breakers for 240-volt AC circuits shall be rated 600 volts AC and shall have a minimum NEMA interrupting capacity of 14,000 symmetrical amperes at 600 volts AC.

#### 2.3.4.4 120-Volt AC Circuits

Air circuit breakers for 120-volt AC circuits shall be rated not less than 120/240 or 240 volts AC and shall have a minimum NEMA interrupting capacity of 10,000 symmetrical amperes.

### 2.3.5 Assembly of Controller

Furnish all necessary air circuit breakers, contactors, relays, resistors,

control transformers, fuses, interlocks, master switches, auxiliary switches, terminal blocks or other devices as shown on the drawings and as required by the scheme of operation. The panel for mounting the relays and contactors shall be sheet steel of sufficient thickness to provide rigid support for the equipment mounted thereon.

#### 2.3.5.1 Wiring

Insulated wire shall conform to the requirements of Section 16120, INSULATED WIRE AND CABLE. All wiring shall be securely held in place and arranged in a neat and orderly manner in horizontal and vertical runs. All wiring passing through steel gutters shall be protected by grommets, unless the openings in the steel gutter are formed to protect the wiring from damage. The wire and terminal numbers shall be neatly and legibly identified in an approved manner. Terminal blocks shall be used for making all external connections.

#### 2.3.5.2 Terminal Blocks

Terminal blocks for control wiring shall be molded type with barriers, rated not less than 600 volts, and they shall be provided with covers. The terminals shall be removable, screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 AWG in size and shall have sufficient length and space for connecting at least two indented terminals on No. 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer.

a. Not less than 10 percent, but in no case less than 2 percent, spare terminals shall be provided on each block. Terminal blocks for conductors larger than No. 10 AWG or with a capacity of more than 30 amperes shall be adequate for the purpose intended, having length and space for at least two indented terminals of the size required on the conductors to be terminated.

b. White or other light-colored marking strips, fastened by screws to the molded sections at each block, shall be provided for circuit designation. Each connected terminal of each block shall have the circuit designation or wire number placed on the marking strip with permanent marking fluid. One reversible or one spare marking strip shall be furnished with each block.

#### 2.3.6 Magnetic Contactors

##### 2.3.6.1 Contactor Ratings

All heavy-duty magnetic contactors shall be of the voltage rating indicated on the drawings or otherwise required. They shall have a horsepower rating not less than the horsepower rating of the motor with which the controller is to be used, but in no case shall the contactor used be smaller than NEMA, Size 1. The contactors shall meet the requirements of NEMA ICS 2 and have continuous current ratings for the duty indicated. Contactors shall be suitable for at least 200,000 complete operations under rated load without more than routine maintenance. They shall operate successfully on 10-percent over-voltage and 15-percent under-voltage. The interrupting capacity shall conform to NEMA standards. Mechanical interlocking between contactors shall be provided as indicated or required and shall be accomplished without any mechanical attachment between the interlocking mechanism and the moving parts of the contactor, unless otherwise approved by the Contracting Officer.

#### 2.3.6.2 Contactors

All current carrying surfaces shall be of a silver alloy or of copper faced with a silver alloy and shall be easily accessible and removable for replacement. Contactor shall operate without chatter or perceptible noise while energized. Coils shall be suitable for continuous operation on the voltage specified.

#### 2.3.6.3 Construction

Each contactor shall be provided with a minimum of three auxiliary contacts, which may be easily changed from normally open to normally closed. Contactor construction shall be such as to prevent corrosion.

#### 2.3.7 Relays

##### 2.3.7.1 Control

Control relay devices shall meet applicable requirements of NEMA ICS 2 for Class A600 contacts. All contacts shall be of a silver alloy or of copper faced with a silver alloy.

##### 2.3.7.2 Overload

Overload relays shall be the adjustable thermal type with normally closed control circuit contacts having a pilot and control circuit contact rating of A600, in accordance with NEMA ICS 2, and shall have combination manual and automatic-type reset. They shall have inverse-time tripping characteristics simulating the heating characteristics of the motor, shall protect the motor with which used against exceeding its specified temperature rise under any overload, stalled rotor, or single-phase condition, and shall be self-protecting under all conditions, except short-circuit. A relay consisting of an assembly of individual-phase thermal elements actuating a common tripping bar shall be used. The means of adjustment shall provide a range from 90 percent to 110 percent of the heater rating and shall be sufficiently accurate to allow setting the relay at the full-load current value of the motor with which used. Reset mechanism shall be trip free and arranged for manual reset in accordance with paragraph "Protection," unless automatic reset is indicated. Reset mechanism shall be of design that will permit changing from manual to automatic reset or vice versa without the use of special tools.

#### 2.3.8 Control Transformer

The control transformer shall be a standard, single-phase, 60-Hz, dry-type, 240/120 volts, and with kVA rating sufficient to supply the control circuits. Transformer shall meet applicable requirements of NEMA ST 1.

#### 2.3.9 Control Circuit Breakers

The control circuit breakers shall conform to the requirements of paragraph "Circuit Breakers," except that an external operating mechanism is not required. Breakers shall be two-pole, 100-ampere frame, and 20-ampere continuous current rating.

#### 2.3.10 Indicating Lights

Indicating lights shall be complete with low-voltage lamps, self-contained

resistor or transformer units, and lens or color caps. Lens and lamp shall be removable from the front. They shall operate on 120 volts AC and be suitable for flush or semiflush mounting to the exterior cabinet door. Exterior mounting of the indication lights shall meet the requirement for the enclosure NEMA type. Hinge wire shall be used for connections between the indicator lights and the terminal block.

#### 2.3.11 Equipment and Door Nameplates

Nameplates shall be provided for the front of the cabinet door and for each item of equipment within the enclosure. Anodized aluminum, stainless steel, or a laminated plastic sheet with black surface layer and a white bottom layer not less than 1/16-inch thick shall be used for the nameplate material. Equipment within the enclosure shall be identified by nameplates or other suitable marking on the equipment unit base or on the panel.

#### 2.3.12 Grounding

The ground connection for the controller enclosing cabinet shall be made by a threaded post fitting which extends through the enclosure wall and which is provided with fittings to connect No. 6 AWG stranded copper ground wire both inside and outside the enclosure. Inside the enclosure, the ground circuit shall be extended with No. 6 AWG stranded copper wire from the connector to the panel.

### 2.4 NEW CONTROL PANEL

Refer to SECTION 16405, PROCESS CONTROL PANELS AND HARDWARE, for control panel requirements.

### 2.5 LIMIT SWITCH

#### 2.5.1 Normal Operation

Limit switches shall be the linear solid-state programmable type with digital display and shall operate on 120 volts AC. It shall contain all the contacts required for making and breaking all control and interlocking circuits necessary for the proper control and operation in the manner specified or required.

#### 2.5.2 Construction

Limit switches shall be of compact and rugged construction, totally enclosed in a NEMA Type 13 case, and housed within the controller enclosure. The cover shall be provided with cap screws or other approved means for readily breaking the cover free for removal unless the gasket is so designed that it will not stick. All parts shall be of corrosion-resisting metal or treated in an approved manner to render it resistant to corrosion. The switch shall permit final adjustment in the field. Tapped bosses shall be provided for making all conduit connections to the switch. A clamp-type connector bolted to the outside of the case shall be provided for making ground connections.

#### 2.5.3 Switches

Switches shall be solid state with current rating as required and shall be assembled or combined into operating units as indicated on the plans. They shall be provided with suitable terminals for connecting the external conductors. Each terminal shall be suitably marked or tagged with the wire

number shown on the Contract Drawings. The tripping mechanism shall be designed for fail-safe operation and shall reset the contacts when moving in the reverse direction. The switch shall have an operator lockout feature which permits programming only by authorized personnel.

#### 2.5.4 Transducer

The electromagnetic position sensor shall be single-turn, heavy-duty enclosed in a outdoor NEMA 4 watertight enclosure. A cable connector used for the enclosure shall be provided and be suitable for No. 16 AWG shield twisted pair.

#### 2.5.5 Accuracy of Trip and Reset

The design of the switch elements and operating mechanism of the limit switch shall provide for uniform and accurate setting. Switch shall be single turn with 1,000 counts per turn and a minimum of 16 set points. The switch shall accurately transmit position within + 3 inches and shall reset gate for drift exceeding 6 inches.

#### 2.6 ENCODER

The encoder shall be a heavy-duty, multi-turn, rotary type, solid state encoder with NEMA 4X housing and shaft seal. Operating range of encoder shall be 20 degrees F to 104 degrees F. It shall be able to measure the full travel of the gate. Encoder shall be provided with all mounting brackets and cover to protect the encoder from the outside elements and damage. It shall provide a 4-20mA output signal.

#### 2.7 WIRE AND CONDUIT

##### 2.7.1 Conductors

Refer to SECTION 16120, INSULATED WIRE AND CABLES.

##### 2.7.2 Conduit

Refer to SECTION 16051, COMMON WORK RESULTS FOR ELECTRICAL.

##### 2.7.3 Fittings

Conduit fittings shall conform to the requirements of NEMA FB 1 and CID A-A-50553.

##### 2.7.4 Assembly

The hoist motor, motor brake, controller, limit switch, encoder, and master control station shall be installed on the as shown on Contract Drawings.

- a. All wiring shall be installed in rigid hot-dip galvanized metal conduit with threaded-type fittings (Condulets) and zinc-coated watertight outlet and pull boxes. The conduit shall be securely mounted and fastened to the hoist framework and shall be installed in a neat and workmanlike manner. Change of direction of a conduit run shall be made by means of threaded-type fittings (Condulets) or factory fabricated bends, and the conduit shall be installed to fit close to the hoist framework. Conduit unions shall be used whenever it is necessary to join conduits that are to be turned right and left. No running threads will be permitted. Ends of conduits shall be carefully



reamed. All threaded connections shall be made up with electrically conductive colloidal copper rust-inhibiting compound or other suitable compound. Separate conduit systems shall be provided for power and control circuits. The entire conduit system shall be grounded and shall be installed so that any moisture will be drained away from terminal boxes and equipment. All conduit connections to equipment enclosures shall be of the watertight threaded type. Suitable "drain-breather" devices shall be provided at all low points of the conduit system to prevent an accumulation of water. All conductors shall be terminated in an approved manner. Indented terminals shall be used on No. 12 AWG and larger conductors and shall be terminated on screw or stud terminals. Toothed lock washers shall be used on all screw terminals and locking nuts or lock washers shall be used on all stud terminals.

### PART 3 EXECUTION

#### 3.1 TESTS

Each item of equipment furnished, one of each rating and type and selected at random by the Contracting Officer, shall be given a complete test. The remaining items of equipment shall be given a routine test. All complete tests required herein shall be witnessed by the Contracting Officer or Contracting Officer's Technical Representative, unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Contracting Officer. Notify the Contracting Officer 14 days in advance of the date of the tests, so that arrangements can be made for the Contracting Officer to be present at the tests. The test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE, and NEMA standards and shall be subject to the approval of the Contracting Officer or Contracting Officer's Technical Representative. Certified copies of "Complete Tests" on duplicate equipment may be accepted with the approval of the Contracting Officer. No substitute will be accepted for the routine test. The cost of performing all tests shall be borne by the Contractor and shall be included in the price bid. Operational tests shall be made on the equipment in conjunction with the tests specified in SECTION 14601, TAINTER GATES AND ANCHORAGES for the assembled hoist.

##### 3.1.1 Motor Tests

All tests shall be performed in accordance with the requirements of IEEE Std 112 for three-phase induction motors.

##### 3.1.1.1 Complete Motor Tests

The complete tests shall include the following:

- a. Excitation test.
- b. Impedance test.
- c. Performance and speed-torque test (Prony brake or other approved method).
- d. Temperature test.
- e. Insulation resistance tests. Measurements shall be taken following temperature test with readings taken at approximately 10C intervals.

Temperature shall be determined by the resistance method.

- f. Dielectric test.
- g. Cold and hot resistance measurement.
- h. Effectiveness of enclosure.
- i. Motor winding heater test.
  - (1) Successful operation.
  - (2) Dielectric.
- j. General operation.
- k. Resistance measurements.

### 3.1.2 Brake Tests

#### 3.1.2.1 Complete Brake Tests

The complete tests shall include the following:

- a. Check operation of brake release at the specified rated brake torque for rated and 85-percent terminal voltage.
- b. Heat run on release magnet at the specified rated brake torque and voltage.
- c. Insulation resistance of release magnet including leads and terminal block.
- d. Resistance measurements of release.
- e. Dielectric test of release magnet including leads and terminal block.

### 3.1.3 Controller Tests

#### 3.1.3.1 Complete Controller Tests

The complete tests shall include all tests listed in paragraph "Routine Controller Tests," and the following:

- a. Effect of voltage and frequency variation.
- b. Temperature test.

#### 3.1.3.2 Routine Controller Tests

The routine tests shall include the following:

- a. Adjustment, fit, and material.
- b. Successful operation.
- c. Resistance.

- d. Dielectric.
- e. Insulation resistance.

#### 3.1.4 Limit Switch Tests

Each switch position shall be tested in the manufacturers shop by suitable means, simulating service conditions, to ascertain that it will transmit the correct information for the control sequence specified. In addition, the routine tests shall include the following:

- a. Adjustment, fit, and material.
- b. Accuracy of trip and reset.
- c. Successful operation.
- d. Dielectric.
- e. Insulation resistance.

#### 3.1.5 Encoder Tests

Encoder tests shall include the following:

- a. Adjustment, fit, and material.
- b. Successful operation through the complete range of motion of the gate.

#### 3.1.6 Wiring Tests

All wiring for circuits rated 240VAC and higher shall be given a dielectric test following installation by applying, for 5 minutes, a voltage test of 1,500 volts to each circuit and ground and between each conductor and all other conductors in the same conduit.

Plate No. 4

CREST GATE  
ELECTRICAL CONTROL SYSTEM  
DESCRIPTION OF CONTROL SYSTEM

1. SCHEME OF OPERATION

a. General. The control system for the gate shall be as indicated by the schematic control wiring diagram, and as specified below.

b. Control Points. The operation of the hoist brake motor shall be controlled by:

(1) Push buttons and selector switch located on the control room control panel with momentary push button contacts designated "RAISE," "LOWER," and "STOP" and selector switch contacts designated "LOCAL" and "REMOTE."

(2) A synchronous type indicator, located on the control room control panel to show the gate position.

c. Operating Features

(1) The control shall utilize interposing relays.

(2) A limit switch geared or directly connected to the hoist machine, shall control the incremental and stopping operations initiated manually from the control station as described under sequence of operation.

(3) Actuation of the "STOP" contact during any operation shall stop the hoist brake motor and set the brake.

Plate No. 5

OUTLET CONTROL GATE  
ELECTRICAL CONTROL SYSTEM  
DESCRIPTION OF CONTROL SYSTEM  
(Single-Speed Motor)

1. SEQUENCE OF OPERATION

a. At Control Panel

(1) The raise and lower button shall be maintained during raising and lowering of the gate, while operator observes the percent open digital read out.

d. Over Travel

(1) Over travel limit switches shall stop the driving motor if it fails to stop at the raised or closed position on the gate.

-- End of Section --