UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

SECTION 35 20 16.46

TAINTER GATES AND ANCHORAGES

01/08

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USACE / NAVFAC / AFCEC / NASA | **UFGS-35 20 16.46 (January 2008)**

Preparing Activity: USACE | **Superseding UFGS-35 20 16.46 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 35 20 16.46

TAINTER GATES AND ANCHORAGES
01/08

****

NOTE: This guide specification covers the requirements for fabrication, assembly, delivery, and installation of tainter gates, anchorage assemblies, and appurtenant items. This section was originally developed for USACE Civil Works projects.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

1.1 UNIT PRICES

****

NOTE: Delete paragraph UNIT PRICES and incorporate appropriately edited paragraphs from below into Section 01 20 00 PRICE AND PAYMENT PROCEDURES.

****

1.1.1 Alternate 1

a. "Furnishing Tainter Gates and Appurtenant Items"

(1) Payment will be made for costs associated with furnishing tainter gates and appurtenant items, which includes full

compensation for materials, fabrication, shop assembly, and delivery of tainter gates, including gates, trunnions, trunnion yokes, trunnion pins, and appurtenant items, including cable attachment brackets, seal assemblies, side seal plates, dogging brackets, sill beams, stop beams, and other items necessary for complete installation.

(2) Unit of measure: lump sum.

b. "Furnishing Tainter Gate Anchorage Assemblies"

(1) Payment will be made for costs associated with furnishing tainter gate anchorage assemblies, which includes full compensation for materials, fabrication, and delivery of tainter gate anchorage assemblies, including tainter gate trunnion girders and prestressing assemblies for anchoring trunnion girders to piers [and trunnion yokes to trunnion girders, and other items necessary for complete installation].

(2) Unit of measure: lump sum

c. "Installing Tainter Gate Anchorage Assemblies"

(1) Payment will be made for cost associated with the complete installation of tainter gates anchorage assemblies.

(2) Unit of measure: lump sum.

1.1.2 Alternate 2

a. "Furnishing and Installing Tainter Gates and Appurtenant Items"

(1) Payment will be made for costs associated with furnishing and installing tainter gates and appurtenant items, which includes full compensation for materials, fabrication, shop assembly, delivery, and installation of tainter gates, including gates, trunnions, trunnion yokes, trunnion pins, and appurtenant items, including cable attachment brackets, seal assemblies, side seal plates, dogging brackets, sill beams, stop beams, and other items necessary for complete installation.

(2) Unit of measure: lump sum.

b. "Furnishing and Installing Tainter Gate Anchorage Assemblies"

(1) Payment will be made for costs associated with furnishing and installing tainter gate anchorage assemblies, which includes full compensation for materials, fabrication, delivery, and installation of tainter gate anchorage assemblies, including tainter gate trunnion girders and prestressing assemblies for anchoring trunnion girders to piers [and trunnion yokes to trunnion girders, and other items necessary for complete installation].

(2) Unit of measure: lump sum.

1.1.3 Alternate 3

"Furnishing and Installing Tainter Gates, Appurtenant Items, and

Tainter Gate Anchorage Assemblies"

(1) Payment will be made for costs associated with furnishing and installing tainter gates, appurtenant items, and tainter gate anchorage assemblies, which includes full compensation for materials, fabrication, shop assembly, delivery, and installation of tainter gates, including gates, trunnions, trunnion yokes, trunnion pins; appurtenant items, including cable attachment brackets, seal assemblies, side seal plates, dogging brackets, sill beams, and stop beams; and tainter gate anchorage assemblies, including tainter gate trunnion girders and prestressing assemblies for anchoring trunnion girders to piers [and trunnion yokes to trunnion girders, and other items necessary for complete installation].

(2) Unit of measure: lump sum.

1.2 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

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	(2020) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A148/A148M	(2020; E 2020) Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A240/A240M	(2020) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A320/A320M	(2017b) Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A490	(2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A501/A501M	(2014) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A564/A564M	(2019) Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A572/A572M	(2018) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	(2019) Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A668/A668M	(2020a) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use

ASTM A722/A722M	(2015) Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM B22/B22M	(2017) Standard Specification for Bronze Castings for Bridges and Turntables
ASTM B148	(2014) Standard Specification for Aluminum-Bronze Sand Castings
ASTM C109/C109M	(2020b) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C939/C939M	(2016a) Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C940	(2016) Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM D395	(2016; E 2017) Standard Test Methods for Rubber Property - Compression Set
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D413	(1998; R 2017) Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D572	(2004; R 2019) Rubber Deterioration by Heat and Oxygen
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness

1.3 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's

Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

SD-03 Product Data

Materials

Prestressing Assemblies; G[, [_____]]

Grout Admixture; G[, [_____]]

Welding; G[, [_____]]

SD-04 Samples

Materials

Manufactured Units; G[, [_____]]

Fabrications; G[, [_____]]

SD-06 Test Reports

Tests, Inspections, and Verifications

SD-07 Certificates

Anchorages and Couplers

Certification of Prestressing Technicians

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 05 50 14 STRUCTURAL METAL FABRICATIONS.

1.4.2 Certification of Prestressing Technicians

Submit certificates, for prestressing technicians who will use the proposed system in the work, 30 days prior to the start of prestressing operations certifying by name that the technicians are trained and skilled in the use of the proposed system.

1.4.3 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.

1.5 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 05 50 14 STRUCTURAL METAL FABRICATIONS. Do not allow prestressing steel materials to come in contact with the earth. Protective wrappings and coverings shall not be removed until immediately prior to use in the work. Each prestressing tendon shall be closely inspected prior to use in the work. Tendons with nicks, pits, bends or damaged threaded ends shall not be used in the work.

1.5.2 Rubber Seals

Store rubber seals in a place which permits free circulation of air, maintains a temperature of 21 degrees C 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

System of identification which shows the disposition of specific lots of approved materials and fabricated items in the work, before completion of the contract. Provide materials orders, materials lists, and materials shipping bills conforming with the requirements of Section 05 50 14 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 05 50 15 CIVIL WORKS FABRICATIONS.

2.1.1.1 Structural Steel Shapes

ASTM A36/A36M.

2.1.1.2 Structural Steel Plates

[ASTM A36/A36M,] [ASTM A572/A572M, Grade 50,] [or] [ASTM A588/A588M, Grade 50].

2.1.1.3 Steel Pipe

[ASTM A53/A53M, Type S, Grade B, seamless, black, normal size and weight class or outside diameter and nominal wall thickness as shown on the drawings, [plain] [threaded] [threaded and coupled] ends.] [ASTM A501/A501M, seamless, outside diameter and nominal wall thickness as shown on the drawings.]

2.1.1.4 Steel Castings

ASTM A27/A27M, Grade [_____], Class [_____]; or ASTM A148/A148M, Grade [_____].

2.1.1.5 Steel Forgings

ASTM A668/A668M, Class [_____], carbon content not exceeding 0.35 per cent, and chemical composition which results in satisfactory weldability.

2.1.1.6 Stainless Steel Bars and Shapes

ASTM A276/A276M, UNS [S 20910,] [S 30400,] [S 40500,] Condition A, hot-finished or cold-finished, Class C; or ASTM A564/A564M, UNS [S 17400,] [S 45000,] Condition A, age-hardened heat treatment, hot-finished or cold-finished, Class C.

2.1.1.7 Stainless Steel Plate, Sheet, and Strip

ASTM A167, UNS S 30400; and ASTM A240/A240M, UNS [S 20910,] [S 30400,] [S 40500,]. Plate finish shall be hot-rolled, annealed or heat-treated, and blast-cleaned or pickled. Sheet and strip finish shall be No. 1.

2.1.1.8 Bronze Castings

ASTM B22/B22M, Copper Alloy UNS No. C91300.

2.1.1.9 Aluminum-Bronze Castings

ASTM B148, Copper Alloy UNS No. [_____].

2.1.1.10 Prestressing Steel Bar Tendons

ASTM A722/A722M, Type [_____], including Supplementary Requirements, except the degree of bending for bend tests shall be 180 degrees.

Certified manufacturing records and test reports for tendons shall be provided, identified with specific lots, and approved prior to use of tendons in the work. Manufacturing records for tendons shall include mixing casting, cooling, rolling, cold-stressing to 80 percent of the minimum ultimate strength, and stress-relieving. Test reports shall include chemical analyses, mechanical properties testing and stress-strain curves, mechanical coupling demonstration, and product analyses of finished tendons representing each heat.

2.1.1.11 Steel Bars for Concrete Reinforcement

Steel bars for concrete reinforcement other than steel bar prestressing tendons shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.1.1.12 Anchorages and Couplers

Submit certificates for anchorages and couplers 30 days prior to the start of prestressing operations. Anchorages and couplers for prestressing tendons shall be of metal of proven corrosion resistance and compatibility with tendons and shall be tested by an approved method and certified to be capable of developing the minimum ultimate strength of tendons without excessive slip. Anchorages shall be plate, bar, or other positive connecting type which allows complete placement and consolidation of concrete around and within its confines and exerts uniform bearing on the concrete. Couplers shall be provided with housing or enclosures which are long enough to permit the necessary movements and fittings which allow complete grouting of all components.

2.1.1.13 Ducts

Ducts for encasing prestressing tendons shall be of the type [shown on the drawings] [approved by the Contracting Officer]. Ducts shall retain shape under the weight of concrete and shall not permit the entrance of cement paste from concrete.

2.1.2 Concrete

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE [and Section 03 45 33 PRECAST[PRESTRESSED] STRUCTURAL CONCRETE].

2.1.3 Asphalt Mastic

Asphalt Mastic shall conform to [_____].

2.1.4 Premolded Expansion Joint Sheets

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.1.5 Gaskets for Seal Assemblies

Rubber gasket sheets for seal assemblies shall have nominal Shore A durometer value of [40][55][80] with dimensions as shown on the drawings.

2.1.6 Rubber Seals

****
NOTE: If fluorocarbon (Teflon) clad seals are not used, delete paragraph FABRICATION below.
****

2.1.6.1 General

Rubber seals shall be [fluoro-carbon (Teflon) clad rubber seals 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	1.38 MPa2500 psi (min.)	ASTM D412
Elongation at Break	450 percent (min.)	ASTM D412
300 percent Modulus	6.21 MPa900 psi (min.)	ASTM D412
Durometer Hardness (Shore Type A)	60 to 70	ASTM D2240
*Water Absorption	5 percent by weight (max.)	ASTM D471
Compression Set	30 percent (max.)	ASTM D395
Tensile Strength (after aging 48 hrs)	80 percent tensile strength (min.)	ASTM D572

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 D471). The immersion temperature shall be 70 degrees C plus or minus 1 degree C and the duration of immersion shall be 166 hours.

2.1.6.2 [Fabrication

Rubber seals shall have a fluoro-carbon film vulcanized and bonded to the sealing surface of the bulb. The film shall be [0.762] [1.524] mm [0.030] [0.060] inch thick Huntington Abrasion Resistant fluoro-carbon Film No. 4508, or equal, and shall have the following physical properties:

Tensile strength	13.8 MPa2,000 psi (min.)
Elongation	250 percent (min.)

The outside surface of the bonded film shall be flush with the surface of the rubber seal and shall be free of adhering or bonded rubber. Strips and corner seals shall be molded in lengths suitable for obtaining the finish lengths shown on the drawings and with sufficient excess length to provide test specimens for testing the adequacy of the adhesion bond between the film and bulb of the seal. At one end of each strip or corner seal to be tested, the fluoro-carbon film shall be masked during bonding to prevent a bond for a length sufficient to hold the film securely during

testing.]

2.1.7 Cement for Grout

ASTM C150/C150M, Type I or II.

2.1.8 Grout Admixture

Submit manufacturer's description of grout admixture, for approval, 30 days prior to the use of the material in the work. Grout admixture shall be a shrinkage compensating type which produces 2 percent maximum and 10 percent maximum unconfined expansion of the grout when tested in accordance with ASTM C940, shall not contain chlorides, fluorides, or nitrates and may be dispensed in solid or liquid form. Complete manufacturer's description of the grout admixture shall be submitted for approval.

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 05 50 15 CIVIL WORKS FABRICATIONS.

2.2.1 Bolts, Nuts and Washers

High-strength bolts, nuts, and washers shall conform to ASTM A325M ASTM A325, Type [_____], [hot-dip galvanized] or ASTM A490, Type [_____]. Bolts, nuts, studs, stud bolts and bolting materials other than high-strength shall conform to ASTM A307, Grade A, [hot-dip galvanized] or ASTM A320/A320M, Ferritic Steel, Grade [_____] [Austenitic Steel, Grade [_____], Class [_____].] Bolts 13-mm 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 on the drawings.

2.3 GROUT

Grout shall be a mixture of Portland cement specified in paragraph CEMENT FOR GROUT, shrinkage compensating admixture specified in paragraph GROUT ADMIXTURE, and potable water. Final mix proportions shall be based on test results of sample mixtures. The water content of grout shall be the minimum necessary for proper placement but the water-cement ratio shall not exceed 0.50 by weight. The fluidity of grout shall be determined in accordance with ASTM C939/C939M. The efflux time of a grout sample immediately after mixing shall not be less than 11 seconds. The minimum 7-day compressive strength of 50-mm 2-inch grout cubes molded, cured and tested in accordance with ASTM C109/C109M shall be 17.2 MPa 2500 psi.

2.4 FABRICATION

2.4.1 Detail Drawings

Submit detail drawings, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, conforming to the requirements specified herein and in Section 05 50 14 STRUCTURAL

METAL FABRICATIONS.

2.4.1.1 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.

2.4.1.2 Shop Assembly Drawings

Provide on the shop assembly drawings details for connecting the adjoining fabricated components in the shop to assure satisfactory field installation.

2.4.1.3 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.

2.4.1.4 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.

2.4.2 Structural Fabrication

Structural fabrication shall conform with the requirements shown on the drawings and specified herein and in Section 05 50 14 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.

2.4.3 Welding

****
NOTE: List applicable welds requiring radiographic examination.
****

Welding shall conform with the requirements [of AWS D1.1/D1.1M, AWS D1.2/D1.2M,] specified herein, and in Section 05 50 14 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 and as follows: [_____]. 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.]

2.4.4 Bolted Connections

Bolted connections shall conform with the requirements specified in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.5 Machine Work

Machine work shall conform with the requirements specified in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.6 Miscellaneous Provisions

Miscellaneous provisions for fabrication shall conform with the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.7 Fabrications

Submit 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.

2.4.7.1 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 A36/A36M. Skin plate shall conform to [ASTM A36/A36M] [ASTM A572/A572M, Grade 50,] [ASTM A588/A588M, 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 6 mm 1/4 inch. The surfaces of framing elements which support skin plates shall be in true alignment within 5 mm 3/16 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 mm 3/16 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. Dowel holes and grease holes shall be drilled in bushings after installation in trunnion hubs. Gates shall be provided with seal

assemblies and other appurtenant items as shown on the drawings.

2.4.7.2 Trunnion Pins

Trunnion pins shall be of [[cast steel conforming to [ASTM A27/A27M] [ASTM A148/A148M]] [alloy steel forging conforming to [ASTM A668/A668M] clad with corrosion resisting steel [weldment] [shrunk-on sleeve] as shown on the drawings. The clad surface shall be machined after completion of all welding. The thickness of the cladding after final machining shall be not less than 25 mm 1 inch thick] [corrosion resisting steel as shown on the drawing]].

2.4.7.3 Trunnion Yokes

Trunnion yokes shall be provided complete with adjusting plates and bolts and thrust washers. Yokes shall be stress-relieved by heat treatment and machined to the class to fit shown on drawings after fabrication welding is completed.

2.4.7.4 Prestressing Anchorage Assemblies

Submit prestressing records immediately after the work is completed. Furnish descriptions of the proposed method for installing the prestressing assemblies, for approval, 30 days prior to the start of prestressing operations. Prestressing assemblies shall consist of prestressing tendons, anchorages, ducts, grout and other appurtenances as required and shown on the drawings.

a. Prestressing tendons shall be as specified in paragraph PRESTRESSING STEEL BAR TENDONS.

b. Anchorages shall be as specified in paragraph ANCHORAGES AND COUPLERS.

c. Ducts shall be as specified in paragraph DUCTS.

d. Grout shall be as specified in paragraph GROUT.

2.4.7.5 Trunnion Girders

Trunnion girders shall be [[cast-in-place] [precast] concrete girders of the 28-day compressive strength shown on the drawings and post-tensioned with prestressing anchorage assemblies. The ducts of the anchorage assemblies shall be cast in the girders in the positions and alignments shown on the drawings. The installation of prestressing assemblies shall be as specified in paragraph PRESTRESSING ANCHORAGE ASSEMBLIES. Reinforcement steel, premolded expansion joint sheets, blockouts and other components of the girders shall be as specified and indicated on the drawings] [structural steel as shown on the drawings].

2.4.7.6 Seal Assemblies

Seal assemblies shall consist of rubber seals, stainless steel retainer and spacer bars, 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 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 and shall be machine-finished after splicing.

2.4.7.7 Appurtenant Items

Cable attachment brackets, dogging brackets, side seal plates, sill beams, stop 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.

2.4.8 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 05 50 14 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 retainers on the gates, match-marked and removed for shipment. Drilled slots for attaching seals shall allow a minimum adjustment of plus/minus 10 mm 3/8 inch. 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.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit certified test reports for material tests with all materials delivered to the site.

2.5.1 General

Tests, inspections, and verifications for materials shall conform to the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.5.2 Testing of Rubber Seals

****
NOTE: If fluoro-carbon (Teflon) clad seals are not used, delete this paragraph.
****

The fluoro-carbon film of rubber seals shall be tested for adhesion bond in accordance with ASTM D413 using either the machine method or the deadweight method. A 25 mm 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 50 mm2 INCHES PER MINUTE	DEADWEIGHT METHOD
0.762 mm0.030 in.	5.25 N per mm30 lbs per inch width	5.25 N per mm30 lbs per inch width
1.524 mm0.060 in.	5.25 N per mm30 lbs per inch width	5.25 N per mm30 lbs per inch width

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation conforming with the requirements specified herein and in Section 05 50 14 STRUCTURAL 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

Seal shapes, seal plates, frames, 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 Trunnion Girders

Trunnion girders shall be anchored to concrete piers as specified and shown on the drawings. [The installation, post-tensioning and grouting of prestressing assemblies for anchoring trunnion girders shall conform to the requirements specified in paragraph PRESTRESSING ASSEMBLIES.]

3.1.3 Trunnion Yokes

Trunnion yokes shall be installed and adjusted in strict accordance with the procedure shown on the drawings. [The final alignment of trunnion yokes shall be performed after the prestressing tendons of the anchoring prestressing assemblies have been post-tensioned partially as specified in paragraph POST-TENSIONING.] 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 0.8 mm 1/32 inch. The horizontal distance between trunnion yokes shall not vary more than 3 mm 1/8 inch from the established dimension. [Second-pour, high-strength concrete fills shall be placed between the bases of trunnion yokes and trunnion girders [and concrete non-shrink grout fills shall be placed between the yokes of trunnion yokes and the abutting faces of concrete piers] after the successful completion of the trial operation specified in paragraph TRIAL OPERATIONS and the

final alignment of trunnion yokes.] [Complete tensioning of the prestressing tendons shall be performed after the concrete fills have attained the minimum [strengths] [strength]. The installation, post tensioning and grouting of prestressing assemblies for anchoring trunnion yokes to trunnion girders shall conform to the requirements specified in paragraph PRESTRESSING ASSEMBLIES.]

3.1.4 Gates

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NOTE: The water-tightness tests on the skinplates should be deleted when complete or spot radiographic or ultrasonic examination of the skinplates is required by the specifications.

****

The trunnion lubrication system lines shall be purged, filled with grease and connected to each trunnion assembly prior to installing gates. The bearing surfaces of trunnion pins and bushings shall be cleaned and coated with grease prior to installing the trunnion pins. 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. [Skinplate welds shall be tested for water-tightness after the gates are installed but prior to painting and mounting of seals by coating one face of the skinplate with soapsuds and applying air pressure with a hose using a minimum air pressure of 414 kPa 60 psi at the nozzle to the opposite face.] Disclosed leaks shall be sealed with light welds.

3.1.5 Prestressing Assemblies

The proposed method and equipment for installing prestressing anchorage assemblies, including riggings, tensioning jacks, gages, dynamometers and load cells or other devices for measuring stress loads, shall provide for the accurate installation of the assemblies and shall be selected by the Contractor and submitted for approval.

3.1.5.1 Ducts

Ducts shall be accurately placed, aligned and adequately supported at close intervals to limit sag and deviation from established lines when tendons are inserted and concrete is placed. Ducts shall have grout openings at both ends and grout vents as required. Connections and other joints in ducts shall be watertight. Openings shall be adequately protected to prevent the entry of water, concrete or debris. Ducts shall not have blockages, dents or other defects which could cause increased friction between tendons and ducts or restrict grout flow.

3.1.5.2 Steel Bar Prestressing Tendons

Steel bar prestressing tendons shall be inspected before being placed in ducts to assure that they are not bent, nicked, scored or have damaged threaded ends. Tendons should not be placed in ducts until all welding has been completed on templates, supports or other items near or in contact with the tendons.

3.1.5.3 Anchorages

Anchorages for steel bar prestressing tendons shall be set in a plan normal to the axis of the tendon so that uniform bearing on the concrete is assured and shall be positively connected to tendons. Ends of tendons shall extend beyond anchorages to accommodate testing. End extensions shall be removed after tests are completed and approved.

3.1.5.4 Post-Tensioning

Complete records of the prestressing operation shall be compiled and submitted as required in paragraph GROUT RECORDS. Tensioning of the steel bar prestressing tendons shall be as specified and shown on the drawings. Tendons shall be tensioned a minimum of [_____] days after the casting of concrete piers [and girders]. Tensioning shall not be started until tests on concrete cylinders made and cured under the same conditions as the piers [and girders] indicate that the concrete has attained the required minimum strength. The tensioning operation shall be conducted in a manner so that the load being applied and the elongation of the tendon may be measured at all times. Elongation measurements shall be accurate to 0.25 mm 0.01 inch. Jack gage readings shall be accurate to the nearest 500 kPa 100 psi. If the stress in a tendon determined by gage pressure differ from the stress determined by elongation measurement in excess of 5 percent the cause of the difference shall be determined and corrected before proceeding with the tensioning operation. [Longitudinal tendons in concrete trunnion girders shall be tensioned prior to the placement of the second-pour, high-strength concrete fills for the sections of piers adjacent to the face of trunnion girders.] [The transverse tendons which anchor trunnion girders to piers shall be tensioned after the second-pour concrete fills for the piers have attained the minimum required strength.] [The transverse tendons which anchor trunnion yokes to trunnion girders shall be partially tensioned prior to the trial operation of tainter gates as specified below in paragraph TRIAL OPERATIONS and prior to the final adjustment of trunnion yokes as specified and shown on the drawings. Complete tensioning of these tendons shall not be performed until after the trunnion yokes have been adjusted and the second-pour, high-strength concrete fills between the base of trunnion yokes and the trunnion girders [and the concrete grout fills between the yokes of trunnion yokes and the piers] have attained the required minimum [strength] [strengths].] Exposed ends of prestressing components shall be protected from damage during the tensioning operations; take the safety measures necessary to prevent accidents caused by failure of prestressing components.

3.1.5.5 Verification of Prestressing Forces

Individual prestressing tendons selected by the Contracting Officer shall be tested to verify the sustentation of prestress forces by being subjected to a force equal to the design force between 7 and 14 days after the complete tensioning of all tendons. Tendons which sustain the applied force without being unseated will be considered to be satisfactory. The number of tendons tested shall not exceed 10 percent of all tendons unless a tested tendon is unable to sustain the required test force. If a tested tendon is unable to sustain the required test force all tendons shall be tested and retensioned if required to the initial prestress. Retensioned tendons shall be retested after 7 days at no additional cost to the Government.

3.1.5.6 Grouting

Prestressing assemblies shall be grouted immediately after complete tensioning of prestressing tendons and verification of prestressing forces. Grout shall conform to the requirements specified in paragraph GROUT. Grouting equipment shall provide continuous mechanical mixing and placing of grout, measure grout mix volume and measure volume of grout placed within 2500 cubic mm 0.1 cubic foot. Grout pump shall be a positive displacement type and have the capacity to develop a pressure of 1.38 MPa 200 psi. Stand-by water flushing equipment shall be provided for flushing out ducts partially grouted and stopped due to blockage or equipment breakdown. Ducts for prestressing tendons shall be flushed free of water, dirt or any other foreign substance and shall be blown out with compressed air until no water comes through just prior to grouting. Ducts shall be pressure grouted at a minimum pressure of 690 kPa 100 psi immediately after post-tensioning has been completed. Grouting shall continue until all air within the duct has been displaced with grout. Once the grouting of a system of prestressing tendons and ducts has been started the grouting operation shall be continuous until that system has been completely grouted. Grout placement records shall be compiled.

3.1.6 Appurtenant Items

Side seal plates, sill beams, stop beams and other items to be embedded in second-pour concrete shall be attached to anchors, aligned, leveled and rigidly blocked to prevent displacement during the placement of concrete. Side seal plates shall be aligned in planes normal to the axis of rotation of the gates and shall be checked before being embedded in concrete to ensure that they do not vary more than 2.5 mm 3/32-inch from the established alignment in an arc length of 3.6 m 12 feet. Welded field splices in exposed metals shall be ground smooth to assure proper sealing. Metal supports for rubber seals shall be continuous and free of waves, winds and distortions. Rubber seals shall be installed after the [skinplate water-tightness test and] gate painting operations have been completed. Seals shall be adjusted after installation so that they are slightly compressed in the closed, unwatered condition to prevent excessive depression and wear in the closed, watered condition. [The heating system for seals shall be installed as shown on the drawings and specified in Section [_____] CREST-GATE-SEAL.]

3.1.7 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 [and between trunnion yokes and trunnion girders and prior to the complete tensioning of the prestressing tendons anchoring the trunnion yokes]. Hoist lifting cables shall be adjusted and trunnion bushings shall be lubricated through the permanent lubrication fittings with an approved, extreme-pressure lubricant 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. Trial operations shall be repeated after complete tensioning and grouting of all prestressing assemblies.

3.1.8 Second-Pour, High-Strength Concrete [and Concrete Grout] Fills

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NOTE: The zones and strengths of high-strength concrete and concrete grout should be shown on the drawings.

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The second-pour, high-strength concrete fills for the sections of piers adjacent to the face of trunnion girders [and the space between the base of trunnion yokes and trunnion girders] [and 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 03 30 00 CAST-IN-PLACE CONCRETE.

3.1.9 Painting

Exposed parts of gates and appurtenances, except machined surfaces, stainless steel surfaces, surfaces of anchorages embedded in concrete, [cathodic protection system anodes,] and other specified surfaces shall be painted as specified in Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES.

3.1.10 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 metal retainers. Before operating the gates, a suitable lubricant shall be applied to the rubber seal rubbing plates to protect the rubber.

3.2 CATHODIC PROTECTION SYSTEM

The cathodic protection system shall conform to Section [26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)] [26 42 19.10 CATHODIC PROTECTION SYSTEMS (IMPRESSED CURRENT) FOR LOCK MITER GATES].

3.3 OPERATING MACHINERY

Operating machinery shall conform to Section 35 01 41.00 10 ELECTROMECHANICAL OPERATING MACHINERY FOR LOCKS.

3.4 FIELD TESTS AND INSPECTIONS

3.4.1 [Skinplate Watertightness Test

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NOTE: Skinplate watertightness tests should be deleted when complete or spot radiographic or ultrasonic examination of the skinplate is required by the specifications.

****

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 414 kPa 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.]

3.4.2 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.

3.5 PROTECTION OF FINISHED WORK

Protection of finished work shall conform to the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

-- End of Section --