Preparing Activity: USACE

Superseding
UFGS-35 20 16.46 (January 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

SECTION 35 20 16.46

HYDRAULIC TAINTER GATES AND ANCHORAGES

08/22

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SECTION 35 20 16.46

HYDRAULIC TAINTER GATES AND ANCHORAGES
08/22

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.

Certain components of a Tainter Gate may be considered fracture critical. These components may include the gudgeon hood, gudgeon anchorage, diagonals, as well as others. AWS D1.1 does not include provisions for fracture critical welding. The Designer should consider using guide specification SECTION 05 59 20 FABRICATION OF HYDRAULIC STEEL STRUCTURES for specifying fracture-critical welding utilizing a Fracture Control Plan. A Fracture Control Plan and the use of appropriate materials and welding is required by ER 1110-2-8157, "Responsibility for Hydraulic Steel Structures."

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: If Section 01 20 00 PRICE AND PAYMENT PROCEDURES is included in the project specifications, this paragraph title (UNIT PRICES) should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 01 20 00.

Select Alternate 1 (one pay item) or Alternate 2 (two pay items). Delete all paragraphs of Alternate not selected.
****

1.1.1 Furnishing and Installing Tainter Gates, Appurtenant Items, and Tainter Gate Anchorage Assemblies

****
NOTE: Alternate 1.
****

1.1.1.1 Payment

Payment is made for costs associated with furnishing and installing Tainter Payment is to 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].

1.1.1.2 Unit of Measure

Unit of measure: lump sum.

1.1.2 Furnishing Tainter Gates, Appurtenant Items, and Tainter Gate Anchorage Assemblies

****
NOTE: Alternate 2.
****

1.1.2.1 Payment

Payment is made for costs associated with furnishing and installing Tainter Payment is to 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].

1.1.2.2 Unit of Measure

Unit of measure: lump sum.

1.1.3 Installing Tainter Gates, Appurtenant Items, and Tainter Gate Anchorage Assemblies

****
NOTE: Alternate 2.
****

1.1.3.1 Payment

Payment is made for costs associated with furnishing and installing Tainter Payment is to 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].

1.1.3.2 Unit of Measure

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; Errata 1 2021) 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	(2022) 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 A240/A240M	(2023) 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	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A564/A564M	(2019) Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A668/A668M	(2023) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A709/A709M	(2021) Standard Specification for Structural Steel for Bridges
ASTM A722/A722M	(2015) Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM A992/A992M	(2022) Standard Specification for Structural Steel Shapes

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	(2021) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C939/C939M	(2022) Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C940	(2022) 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; R 2021) 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
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

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

Fabrication Drawings; G[, [_____]]

Shop Assembly Drawings; G[, [_____]]

Delivery Drawings; G[, [_____]]

Field Installation Drawings; G[, [_____]]

Stress Relieving Plan; G[, [_____]]

Fracture Control Plan (FCP); G[, [_____]]

Handling Attachments and Pick Points; G[, [_____]]

SD-03 Product Data

Materials

Prestressing Assemblies

Grout Admixture

SD-04 Samples

Materials; 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

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.

1.5 DELIVERY, STORAGE, AND HANDLING

Perform delivery, handling, and storage of materials and fabricated items in accordance with the requirements specified [herein and] in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. [Unload material and equipment delivered to the site as approved by the Contracting Officer. Verify the condition and quantity of the items delivered and acknowledge receipt and condition thereof in writing to the Contracting Officer. If delivered items are damaged or a shortage is determined, notify the Contracting Officer of such in writing within 24 hours after delivery.]

1.5.1 Rubber Seals

Store rubber seals in a place which permits free circulation of air, maintains a temperature of 20 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. Do not distort rubber seals during handling.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

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.

2.1.1.1 Fabrication Drawings

Show on the fabrication drawings complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

2.1.1.2 Shop Assembly Drawings

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

2.1.1.3 Delivery Drawings

Show 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.

2.1.1.4 Field Installation Drawings

Show on the field installation drawings a detailed description of the field installation procedures. Include in the description 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, including descriptions of connections, riggings, anchorages, and measuring equipment; methods for installing quoin and miter blocks, including checking and maintaining alignments of the blocks during concreting and placement of [epoxy] [zinc] filler; [procedures and equipment used for heating and placing of the zinc filler;] and methods for installing other appurtenant items.

2.2 MATERIALS

Submit a 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.

2.2.1 Metals

****
NOTE: Consider the use of ASTM A709/A709M steel for fabrication of all steel components. A709 material is available in 36 and 50 ksi and provides improved toughness and maximum yield to tensile ratios to ensure ductile performance.
****

Provide structural steel, steel forgings, steel castings, stainless steel, bronze, aluminum-bronze, and other metal materials used for fabrication conforming with the requirements shown on the drawings and specified herein and in Section 05 50 15 CIVIL WORKS FABRICATIONS.

2.2.1.1 Structural Steel Shapes

Conform to [ASTM A36/A36M][ASTM A572/A572M][ASTM A992/A992M][ASTM A709/A709M].

2.2.1.2 Structural Steel Plates

[ASTM A36/A36M][or][ASTM A572/A572M], Grade 50[ASTM A709, Grade 50].

2.2.1.3 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.]

2.2.1.4 Steel Castings

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

2.2.1.5 Steel Forgings

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

2.2.1.6 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.

2.2.1.7 Stainless Steel Plate, Sheet, and Strip

ASTM A240/A240M, UNS [S 20910,] [S 30400,] [S 40500,]. Finish plates by hot-rolling, annealing or heat-treating, and blast-cleaning or pickling. Provide No. 1 grade sheet and strip finish.

2.2.1.8 Bronze Castings

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

2.2.1.9 Aluminum-Bronze Castings

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

2.2.1.10 Prestressing Steel Bar Tendons

ASTM A722/A722M, Type [_____], including Supplementary Requirements, except provide 180 degrees of bending for bend tests. Provide certified manufacturing records and test reports for tendons, identified with specific lots, and approved prior to use of tendons in the work. Include mixing casting, cooling, rolling, cold-stressing to 80 percent of the minimum ultimate strength, and stress-relieving for all manufacturing records. Include chemical analyses, mechanical properties testing and stress-strain curves, mechanical coupling demonstration, and product analyses of finished tendons representing each heat for all test reports.

2.2.1.11 Steel Bars for Concrete Reinforcement

Provide steel bars for concrete reinforcement other than steel bar prestressing tendons as specified in Section 03 23 00 STRESSED TENDON REINFORCING.

2.2.2 Anchorages and Couplers

Submit certificates for anchorages and couplers 30 days prior to the start of prestressing operations. Provide anchorages and couplers for prestressing tendons made of metal of proven corrosion resistance and compatibility with tendons and test by an approved method and certified to be capable of developing the minimum ultimate strength of tendons without excessive slip. Provide anchorages made of 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. Provide couplers with housing or enclosures which are long enough to permit the necessary movements and fittings which allow complete grouting of all components.

2.2.3 Ducts

Provide ducts for encasing prestressing tendons of the type [shown on the drawings] [approved by the Contracting Officer]. Ensure ducts retain shape under the weight of concrete and prevent the entrance of cement paste from concrete.

2.2.4 Concrete

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

2.2.5 Asphalt Mastic

Provide asphalt mastic in conformance with [_____].

2.2.6 Premolded Expansion Joint Sheets

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

2.2.7 Gaskets for Seal Assemblies

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

2.2.8 Rubber Seals

Provide rubber seals that are [fluorocarbon (Teflon) clad rubber seals of the mold type only, and] compounded of natural rubber, synthetic polyisoprene, or a blend of both, and contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers.

2.2.8.1 Physical Characteristics

Ensure seals exhibit physical characteristics that 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

Perform the "Water Absorption" test using distilled water. Blot the washed specimen 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 for 22 plus or minus 1/4 hour. Remove the specimen and allow to air cool to room temperature, and weigh the specimen. Record the weight the nearest 1 mg as M subscript 1 (M subscript 1 is defined in ASTM D471). Ensure the immersion temperature is 70 degrees C plus or minus 1 degree and the immersion duration is at least 166 hours.

[2.2.8.2 Fabrication of Rubber Seals

Provide rubber seals with a fluorocarbon film that is vulcanized and bonded to the sealing surface of the bulb. Ensure the film thickness is [0.762] [1.524] mm [0.030] [0.060] inch and is Huntington Abrasion Resistant Fluorocarbon Film No. 4508, or equal, and has the following physical properties:

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

Flush the outside surface of the bonded film with the surface of the rubber seal and ensure it is free of adhering or bonded rubber. Mold strips and corner seals in lengths suitable for obtaining the finish lengths shown 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, mask the fluorocarbon film during bonding to prevent a bond for a length sufficient to hold the film securely during testing.

]2.2.9 Grout

Provide grout made of a mixture of Portland cement specified in paragraph CEMENT FOR GROUT, shrinkage compensating admixture specified in paragraph GROUT ADMIXTURE, and potable water. Base final mix proportions on test results of sample mixtures. Minimize the water content of grout to achieve proper placement but never to exceed 0.50 by weight. Determine the fluidity of grout in accordance with ASTM C939/C939M. Limit efflux

time of a grout sample immediately after mixing to less than 11 seconds. In all cases, the minimum value of the 7-day compressive strength of 50-mm 2-inch grout cubes molded, cured and tested in accordance with ASTM C109/C109M is 17.2 MPa 2500 psi.

2.2.9.1 Cement for Grout

ASTM C150/C150M, Type I or II.

2.2.10 Grout Admixture

Submit manufacturer's description of grout admixture, for approval, 30 days prior to the use of the material in the work. Provide grout admixture of the shrinkage compensating type which produces 2 percent maximum and 10 percent maximum unconfined expansion of the grout when tested in accordance with ASTM C940, and is free of chlorides, fluorides, or nitrates and dispensable in solid or liquid form. Submit complete manufacturer's description of the grout admixture for approval.

2.3 MANUFACTURED UNITS

Ensure bolts, nuts, washers, screws and other manufactured units conform with the requirements shown on the drawings and specified herein and in Section 05 50 15 CIVIL WORKS FABRICATIONS.

2.3.1 Manufactured Units and Fabricated Items

Provide full-size samples of manufactured units and shop fabricated items 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.

2.3.2 Bolts, Nuts and Washers

Provide high-strength bolts, nuts, and washers in conformance with ASTM F3125/F3125M, Grade A325, [hot-dip galvanized]. Provide bolts, nuts, studs, stud bolts and bolting materials other than high-strength items in conformance with ASTM A307, Grade A, [hot-dip galvanized] or ASTM F3125/F3125M, Ferritic Steel, Grade [_____] [Austenitic Steel, Grade [_____], Class [_____].] Provide bolts 13-mm 1/2-inch and larger with hexagon heads. Ensure the finished shank of bolts is long enough to provide full bearing. Provide washers for use with bolts in conformance with the requirements specified in the applicable specification for bolts.

2.3.3 Screws

Provide screws of the type indicated on the drawings.

2.4 FABRICATION

2.4.1 Structural Fabrication

Ensure all structural fabrications conform with the requirements shown and specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Shop-fabricated of the materials specified and shown. Ensure dimensional tolerances comply with the specifications and as shown on the drawings. Splices are only allowed where shown or approved. Bore pin holes in components after welding, straightening, stress-relieving, and threading operations are completed. Brackets, eye bar sections, and other

components requiring straightening are only to be straightened by methods which do not damage the material. Press-fit bronze bushings with supporting components. Provide bolt connections, lugs, clips, or other pick-up assembly devices for components as shown and required for proper assembly and installation. Make provisions for the installation of [cathodic protection system devices and other] appurtenances as required.

2.4.2 Welding

****

NOTE: List applicable welds requiring radiographic examination.

NOTE: Specification Section 05 50 14 STRUCTURAL METAL FABRICATIONS includes welds subjected to Ultrasonic Testing (UT), Dye Penetrant Testing (PT) and Magnetic Testing (MT). AWS D1.1 does not specify nondestructive testing of any completed weld. Designer must take this into account and specify any Nondestructive Testing (NDT) requirements as well as specifying which welds are to be subjected to nondestructive testing.

The designer is to consider whether any components included are likely to be fracture critical. Fracture critical components should be identified as requiring fabrication in accordance with a Fracture Control Plan.

****

Ensure welding conforms to the requirements of AWS D1.1/D1.1M, AWS D1.2/D1.2M, the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Provide welds of the types 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, by dye penetrant, magnetic particle tests, or ultrasonic tests. All components are to be stress-relief heat treated after welding where shown. Perform stress-relieving of components prior to the attachment of miscellaneous appurtenances. Submit a Stress Relieving Plan for approval which follows the minimum requirements for thermal stress relief in accordance with AWS D1.1.[Stress-relief heat treat all components after welding where shown. Perform stress-relieving of components prior to the attachment of miscellaneous appurtenances.][Refer to Specification SECTION 05 50 14 STRUCTURAL METAL FABRICATIONS for nondestructive testing requirements.][Submit a Fracture Control Plan (FCP) for fracture critical components.]

2.4.3 Bolted Connections

Provide bolted connections in conformance with the requirements specified in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.4 Machine Work

Ensure machine work conforms to the requirements specified in Section

05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.5 Miscellaneous Provisions

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

2.4.6 Fabrications

Submit samples for approval prior to use of the represented materials or items in the work. Submit samples of standard and shop fabricated items that are 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.

2.4.6.1 Gates

Fabricate gates of welded fabrication except for bolted appurtenances as shown on the drawings. Provide structural steel framing members of structural steel conforming to ASTM A709/A709M, Grade 50. Provide skin plate conforming to [ASTM A709/A709M] [or] [ASTM A572/A572M], Grade 50. Shop-fabricate all gate. Obtain Contracting Officer approval for Contractor proposed shop-fabrication of gate leave in separate segments to facilitate handling and shipping as shown on approved detail drawings. Ensure segments permit easy field-assembly in as few sections as practicable to minimize the number of joints to be field-welded. Ensure the overall height of gates does not vary from the nominal dimension by more than 6 mm 1/4 inch. Ensure the surfaces of framing elements which support skin plates are 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. Ensure the outside faces of skin plates after being welded to framing elements vary from the surface established on the drawings by no more than 5 mm 3/16 inch. Locate splices in skin plates only where shown on the drawings. Provide trunnions as an integral part of the gate framing and stress-relieve them by heat treatment after welding. Machine trunnion hubs and bushings after welding of the hubs is completed. Classify fit between trunnion hubs and bushings as shown on the drawings. Drill dowel holes and grease holes in bushings after installation in trunnion hubs. Provide gates with seal assemblies and other appurtenant items as shown on the drawings.

2.4.6.2 Trunnion Pins

Provide trunion pins fabricated from stainless steel, ASTM A564/A564M, UNS S17400 condition H1100 with an outside diameter surface finish roughness not to exceed 0.41 micrometers16 microinches, unless otherwise shown on the drawings.

2.4.6.3 Trunnion Yokes

Provide trunnion yokes complete with adjusting plates and bolts and thrust washers. Stress-relieve yokes by heat treatment and machine to the class to fit shown on drawings after fabrication welding is completed.

2.4.6.4 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 consist of prestressing tendons, anchorages, ducts, grout and other appurtenances as required and shown on the drawings.

a. Provide prestressing tendons as specified in paragraph PRESTRESSING STEEL BAR TENDONS.

b. Provide anchorages as specified in paragraph ANCHORAGES AND COUPLERS.

c. Provide ducts as specified in paragraph DUCTS.

d. Provide grout as specified in paragraph GROUT.

2.4.6.5 Trunnion Girders

Provide trunnion girders constructed of [[cast-in-place] [precast] concrete girders with the 28-day compressive strength shown on the drawings and post-tensioned with prestressing anchorage assemblies. Cast the ducts of the anchorage assemblies in the girders in the positions and alignments shown on the drawings. Install prestressing assemblies as specified in paragraph PRESTRESSING ANCHORAGE ASSEMBLIES. Provide reinforcement steel, premolded expansion joint sheets, blockouts and other components of the girders as specified and indicated on the drawings] [structural steel as shown on the drawings].

2.4.6.6 Seal Assemblies

Seal assemblies consist of rubber seals, stainless steel retainer and spacer bars, and fasteners. Provide continuous rubber seals over the full length. Accurately fit and drill seals for proper installation. Drill bolt holes in the rubber seals by using prepared templates or the retainer bars as templates. Ensure all splices in seals are fully molded, and develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown on the drawings. Shop-vulcanize splices. Locate vulcanized splices between molded corners and straight lengths as close to the corners as practicable. Bevel splices on a 45 degree bevel related to the "thickness" of the seal. Ensure finished splice surfaces are smooth and free of irregularities. Field-splice stainless steel retainer bars only where shown on the drawings and machine-finish-retainer bars after splicing.

2.4.6.7 Appurtenant Items

Provide cable attachment brackets, dogging brackets, side seal plates, sill beams, stop beams and other appurtenant items in conformance with the requirements specified and shown on the drawings. Ensure all sealing surfaces of side seal plates and sill beams are flush, straight, and free from offsets, warps, twists or other distortions.

2.4.7 Shop Assembly

Comply with all shop assembly requirements for Tainter gates, anchorage assemblies and appurtenant items as shown on the drawings and specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Assemble gates completely in the shop to assure satisfactory field installation. Fit and bolt adjoining components and appurtenant items together to facilitate field connections. Shop-weld assembled components in their

final positions as much as delivery and field installation conditions permit. Fit and drill rubber seals to match the seal retainers on the gates, match-marked and removed for shipment. Allow a minimum adjustment of plus/minus 10 mm 3/8 inch in all drilled slots for attaching seals. Perform shop assembly and disassembly work 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 in no way relieves the Contractor of any responsibility under this contract.

2.5 COMPONENTS

2.5.1 Cathodic Protection System

Provide cathodic protection system in conformance with Section [26 42 17 IMPRESSED CURRENT CATHODIC PROTECTION (ICCP) SYSTEM] [26 42 19.10 CATHODIC PROTECTION SYSTEMS (IMPRESSED CURRENT) FOR LOCK MITER GATES].

2.5.2 Operating Machinery

Provide operating machinery in conformance with Section 35 01 41.00 10 ELECTROMECHANICAL OPERATING MACHINERY FOR LOCKS AND DAMS.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

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

2.6.1 General

Tests, inspections, and verifications for materials are to be performed in conformance with the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.6.2 Testing of Rubber Seals

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

Test the fluoro-carbon film of rubber seals for adhesion bond in accordance with ASTM D413 using either the machine method or the deadweight method. Cut a 25 mm 1 inch long piece of seal from the end of the seal which has been masked and subjected to tension at an angle approximately 90 degrees to the rubber surface. Ensure there is 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

THICKNESS OF FLUORO-CARBON FILM	MACHINE METHOD AT 50 mm2 INCHES PER MINUTE	DEADWEIGHT METHOD
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

Installation per the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Assemble miter gates and appurtenant items for installation in strict accordance with the contract drawings, approved installation drawings, and shop match-markings. Thoroughly clean and lubricate bearing surfaces requiring lubrication with an approved lubricant before assembly and installation. Ensure components to be field-welded are placed in correct alignment before welding is commenced. Design and submit handling attachments and pick points required to be added to any specified items herein prior to installation.

3.1.1 Embedded Metals

Accurately install sill assemblies, seal plates, frames, bases and other embedded metal items required for proper and complete installation to the alignment and grade required to ensure accurate fitting and matching of components. Primer coat all embedded metals with the required paint on all surfaces prior to installation in concrete forms. Install anchors for embedded metals as shown. Attach items requiring two concrete pours for installation to the embedded anchors after the initial pour, adjusted to the proper alignment, and concreted in place with the second pour. Grind smooth welded field splices in sealing surfaces of embedded items.

3.1.2 Trunnion Girders

Anchor trunnion girders to concrete piers as specified and shown on the drawings. [Ensure the installation, post-tensioning and grouting of prestressing assemblies for anchoring trunnion girders conforms to the requirements specified in paragraph PRESTRESSING ASSEMBLIES.]

3.1.3 Trunnion Yokes

Install and adjust trunnion yokes in strict accordance with the procedure shown on the drawings. [Perform the final alignment of trunnion yokes after the prestressing tendons of the anchoring prestressing assemblies have been post-tensioned partially as specified in paragraph POST-TENSIONING.] Use special precautions 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. Ensure the eccentricity of the actual centerline of each trunnion pin with respect to the established horizontal line is no more than 0.8 mm 1/32 inch. Limit horizontal distance variance between trunnion yokes to no more than 3 mm 1/8 inch from the established dimension. [Place second-pour, high-strength concrete fills between the bases of trunnion yokes and trunnion girders [and place concrete non-shrink grout fills 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.] [Perform

complete tensioning of the prestressing tendons after the concrete fills have attained the minimum [strengths] [strength]. Ensure the installation, post tensioning and grouting of prestressing assemblies for anchoring trunnion yokes to trunnion girders conforms to the requirements specified in paragraph PRESTRESSING ASSEMBLIES.]

3.1.4 Gates

****
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.
****

Purge the trunnion lubrication system lines, fill with grease and connect to each trunnion assembly prior to installing gates. Clean the bearing surfaces of trunnion pins and bushings and coat with grease prior to installing the trunnion pins. Assemble gates in the field in strict conformity with shop match markings. Check controlling dimensions and alignments and correct as required before starting field welding. Weld in a manner such that distortion of gates is prevented. Remove erection bolts, lugs and ties after welding is completed. Fill holes and depressions with weld metal and remove surface projections by grinding. [Test skinplate welds 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.] Seal disclosed leaks with light welds.

3.1.5 Prestressing Assemblies

Select and submit for approval 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. Selected method is required to provide for the accurate installation of all assemblies.

3.1.5.1 Ducts

Accurately place ducts, align and adequately support at close intervals to limit sag and deviation from established lines when tendons are inserted and concrete is placed. Install ducts with grout openings at both ends and grout vents as required. Ensure connections and other joints in ducts are watertight. Adequately protect openings to prevent the entry of water, concrete or debris. Ensure ducts have no 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

Inspect steel bar prestressing tendons before placing in ducts to assure that they are not bent, nicked, scored or have damaged threaded ends. Do not place tendons 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

Set anchorages for steel bar prestressing tendons in a plan normal to the

axis of the tendon so that uniform bearing on the concrete is assured and anchorages are positively connected to tendons. Extend ends of tendons beyond anchorages to accommodate testing. Remove end extensions after tests are completed and approved.

3.1.5.4 Post-Tensioning

Compile and submit complete records of the prestressing operation as required in paragraph GROUT RECORDS. Tension the steel bar prestressing tendons as specified and shown on the drawings. Tension tendons a minimum of [_____] days after the casting of concrete piers [and girders]. Do not begin tensioning 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. Conduct the tensioning operation in a manner so that the load being applied and the elongation of the tendon may be measured at all times. Ensure elongation measurements are accurate to 0.25 mm 0.01 inch. Ensure jack gage readings are 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, determine the cause of the difference and corrected before proceeding with the tensioning operation. [Tension longitudinal tendons in concrete trunnion girders prior to the placement of the second-pour, high-strength concrete fills for the sections of piers adjacent to the face of trunnion girders.] [Tension the transverse tendons which anchor trunnion girders to piers after the second-pour concrete fills for the piers have attained the minimum required strength.] [Partially tension the transverse tendons which anchor trunnion yokes to trunnion girders 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. Do not complete tensioning of these tendons 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].] Protect exposed ends of prestressing components 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

Tested the individual prestressing tendons selected by the Contracting Officer 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. A tendon which sustains the applied force without being unseated is considered to be satisfactory. Test no more than 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, retest all tendons and retension if required to the initial prestress. Retest retensioned tendons after 7 days at no additional cost to the Government.

3.1.5.6 Grouting

Grout prestressing assemblies immediately after complete tensioning of prestressing tendons and verification of prestressing forces. Provide grout in conformance with the requirements specified in paragraph GROUT. Provide grouting equipment capable of continuous mechanical mixing and placing of grout, measuring grout mix volume and measuring volume of grout

placed within 2500 cubic mm 0.1 cubic foot. Provide a positive displacement type grout pump with the capacity to develop a pressure of 1.38 MPa 200 psi. Provide stand-by water flushing equipment for flushing out ducts partially grouted and stopped due to blockage or equipment breakdown. Flush ducts for prestressing tendons free of water, dirt or any other foreign substance and blow out with compressed air until no water comes through just prior to grouting. Pressure grout ducts at a minimum pressure of 690 kPa 100 psi immediately after post-tensioning has been completed. Continue grouting until all air within the duct has been displaced with grout. Continue the grouting of a system of prestressing tendons and ducts once started until that system has been completely grouted. Compile and track grout placement records.

3.1.6 Appurtenant Items

Attach side seal plates, sill beams, stop beams and other items to be embedded in second-pour concrete to anchors, align, level and rigidly block to prevent displacement during the placement of concrete. Align side seal plates in planes normal to the axis of rotation of the gates and check before embedding in concrete to ensure 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. Grind welded field splices in exposed metals smooth to assure proper sealing. Provide continuous metal supports for rubber seals that are free of waves, winds and distortions. Install rubber seals after the [skinplate water-tightness test and] gate painting operations have been completed. Adjust seals after installation so that they are slightly compressed in the closed, unwatered condition to prevent excessive depression and wear in the closed, watered condition. [Install the heating system for seals as shown on the drawings and specified in Section [_____] CREST-GATE-SEAL.]

3.1.7 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.

****

Execute 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] as shown on the drawings and as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.1.8 Painting

Paint 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 as specified in Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES.

3.1.9 Seal Assemblies

Install rubber seal assemblies after the embedded metal components have been concreted in place and the gate installation, including painting, completed. Fasten rubber seals securely to metal retainers. Before operating the gates, apply a suitable lubricant to the rubber seal rubbing plates to protect the rubber.

3.2 FIELD QUALITY CONTROL

Non-Destructive testing of field welds are required to meet the same quality control requirements of shop-welded components.

3.3 SYSTEM START-UP

3.3.1 Trial Operations

Perform gate trial operations after the complete installation of gates and appurtenant items. Perform trial operations and receive approval 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]. Adjust hoist lifting cables and lubricate trunnion bushings through the permanent lubrication fittings with an approved, extreme-pressure lubricant before operating the gates. Adjust guide shoes, guide rollers, and bulb seals as necessary. Ensure gates move smoothly and without binding or lateral sway when raised and lowered through the complete range of travel. Correct defects disclosed from trial operations and repeat trial operations at no cost to the Government. Repeat trial operations after complete tensioning and grouting of all prestressing assemblies. Refer to Section 35 01 70.13 WIRE ROPE FOR GATE OPERATING DEVICES for wire rope tensioning procedures.

3.3.2 Acceptance Trial Operation

After completion of the gate installation, conduct an examination of the gates in the presence of the Contracting Officer for final acceptance. First examine the gates to determine whether or not the workmanship conforms to the specification requirements. 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. Adjust guide shoes, guide rollers, and bulb seals as necessary. The workmanship in the fabrication and installation of gates is the result in a condition where when the gates are in the closed position watertight barrier is formed across the opening. The contractor is required to make all repairs or replacements to correct defects, as determined by the Contracting Officer, at no cost to the Government. Repeat the trial operation after defects are corrected. Prior to final acceptance of the gates, provide temporary restraints to prevent unauthorized operation of the gates.

3.4 PROTECTION

Protect finished work in conformance with the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

-- End of Section --