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USACE / NAVFAC / AFCEC / NASA **UFGS-35 20 16.33 (August 2022)**

Preparing Activity: USACE **Superseding**
UFGS-35 20 16.33 (January 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2022
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DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

SECTION 35 20 16.33

HYDRAULIC MITER GATES

08/22

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****

SECTION 35 20 16.33

HYDRAULIC MITER GATES
08/22

****
NOTE: This guide specification covers the requirements for the fabrication, assembly, delivery, and installation of miter gates and appurtenant items as specified and shown. This section was originally developed for USACE Civil Works projects.

Certain components of a Miter 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 Miter Gates

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

1.1.1.1 Payment

Payment is made for costs associated with furnishing and installing miter gates and appurtenant items, which includes full compensation for the materials, fabrication, delivery, installation, and testing of miter gates and appurtenant items including gate leaves, diagonals, strut connections, miter guides, miter latches, recess latch strikes, quoin and miter contact blocks, gudgeon top anchorages, pintle assemblies, [walkways,] [bridgeways,] gudgeon embedded anchorages, wall quoins, sill assemblies, seal assemblies, recess latches, bumpers, fenders, and all other items necessary for complete installation.

1.1.1.2 Unit of Measure

Unit of measure: lump sum.

1.1.2 Furnishing Miter Gates

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

1.1.2.1 Payment

Payment is made for costs associated with furnishing miter gates and appurtenant items, which includes full compensation for the materials, fabrication, and delivery of miter gates and appurtenant items including gate leaves, diagonals, strut connections, miter guides, miter latches, recess latch strikes, quoin and miter contact blocks, gudgeon top anchorages, pintle assemblies, [walkways,] [bridgeways,] gudgeon embedded anchorages, wall quoins, sill assemblies, seal assemblies, recess latches, bumpers, fenders, and other items necessary for complete installation.

1.1.2.2 Unit of Measure

Unit of Measure: lump sum.

1.1.3 Installing Miter Gates

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

1.1.3.1 Payment

Payment is made for costs associated with the installation of miter gates and appurtenant items, which includes full compensation for the complete installation and testing of miter gates and appurtenant items.

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

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA M6	(2013) Brands Used on Preservative Treated Materials

ASTM INTERNATIONAL (ASTM)

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 A240/A240M	(2020a) 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 A320/A320M	(2021a) Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
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	(2022) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A709/A709M	(2021) Standard Specification for Structural Steel for Bridges
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM B6	(2018) Standard Specification for Zinc
ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
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 D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D572	(2004; R 2019) Rubber Deterioration by Heat and Oxygen
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D792	(2013) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D3019	(2008) Lap Cement Used with Asphalt Roll Roofing Non Fibered, Asbestos Fibered, and Non Asbestos Fibered
ASTM D4020	(2011) Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
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

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 9.01	(1982; E 2004) Cold-Applied Asphalt Mastic Painting System with Extra-Thick Film

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

Diagonals Prestressing Plan; G[, [_____]]

Gudgeon Embedded Anchorage; G[, [_____]]

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

Gudgeon Embedded Anchorage

SD-04 Samples

Materials; G[, [_____]]

SD-06 Test Reports

Diagonals Prestressing Records

Tests, Inspections, and Verifications

SD-07 Certificates

Epoxy Filler

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.

1.5 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.

[1.5.2 Epoxy Filler

Deliver epoxy filler from the manufacturer just prior to use in the work to insure receipt of recently manufactured material and store under cover, out of direct sunlight, at a temperature between 20 to 30 degrees C 65 to 85 degrees F.

]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 system of identification which shows the disposition of specific lots of approved materials and fabricated items in the work, before completion of the contract. Ensure materials orders, materials lists and materials shipping bills conform to the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Submit approved samples prior to use of the represented materials or items in the work. Submit samples of standard and shop fabricated items that are both 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.

2.2.1 Metals

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

Ensure structural steel, steel forgings, steel castings, stainless steel, bronze, aluminum bronze and other metal materials used for fabrication conform to the requirements shown and specified herein and in Section 05 50 15 CIVIL WORKS FABRICATIONS.

2.2.1.1 Structural Steel

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

2.2.1.2 Structural Steel Plates

Conform to [ASTM A36/A36M] [ASTM A572/A572M, Grade 50] [ASTM A709/A709M, Grade 50].

2.2.1.3 Steel Pipe

Conform to ASTM A53/A53M, Type S, Grade B, seamless, black, nominal size and weight class or outside diameter and nominal wall thickness as shown, [plain] [threaded] [threaded and coupled] ends.

2.2.1.4 Stainless Steel Bars and Shapes

Conform to 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.

2.2.1.5 Stainless Steel Plate, Sheet, and Strip

Conform toASTM 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 sheet and strip finish.

2.2.2 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.

2.2.2.1 Physical Characteristics

Ensure seals exhibit physical characteristics that meet the following requirements:

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
Tensile Strength	20.7 MPa3,000 psi (min.)	ASTM D412
Elongation at Break	500 percent (min.)	ASTM D412
300 percent Modulus	6.9 MPa1,000 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, Method B

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
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.

[2.2.2.2 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.

][2.2.3 Epoxy Filler

Use epoxy filler that is an approved epoxy resin formulation equal to "Loctite Nordback," a product of Hennkel Adhesives, or an approved equal, with a specific gravity of 1.90 to 1.95, minimum compressive strength after 72 hours at 20 degrees C 70 degrees F of 89.6 MPa 13,000 psi, and maximum shrinkage of 0.15 percent. Submit Manufacturer's certificate for epoxy filler stating that it meets or exceeds the specified physical properties; Deliver material to the site.

][2.2.4 Zinc Filler

2.2.4.1 Material

Comply with ASTM B6.

[2.2.4.2 Safety Provisions for Zinc Filler

The following special safety provisions are required for heating and placing zinc filler:

a. Ensure workers wear protective clothing including hard hats with fine wire mesh screen, goggles, leather sleeves, chaps, apron, and leather gloves.

b. Ensure workers wear air-line respirators certified by National Institute for Occupational Safety and Health (NIOSH) or Mine Safety and Health Administration (MSHA). In enclosed spaces, both local exhaust ventilation and air-line respirators are required. Provide local exhaust ventilation consisting of movable hoods placed close to the work to remove fumes at the source.

c. Pre-heat ladles, equipment, and material before being used so they are moisture-free.

d. Place heating devices and ladles on a level, firm foundation, and protected against traffic, accidental tipping, or similar hazard.

e. Do not carry hot zinc up or down ladders.

f. Use buckets or vessels handling and transporting hot zinc that are substantially constructed and fill them higher than 100 mm 4 inches from the top.

]][2.2.5 Bumpers and Fenders

****
NOTE: Designer should consult ERDC-CERL TR-17-37 "Material Selection for Bumpers and Fenders for Lock Gates and Guidewalls" prior to specifying Bumpers and Fenders. The designer needs to evaluate the specifics each installation prior to selecting a material. Selection should be based on relative merit in terms of selection criteria such as first cost, frequency and duration of lock closures for repairs, ability to protect the gate, ability to survive impact(s), weather resistance, maintainability and aesthetics.
****

Provide rubber bumpers and fenders designed specifically for a marine environment.

2.2.5.1 HDPE Bumpers and Fenders

Provide High Density Polyethylene (HDPE) fenders that are [_____] in color, [with four (25cm1 in) diameter fiberglass bars embedded in the fender cross section]. Ensure provided fenders include an ultraviolet stabilizer. Provide fenders with actual dimensions of [_____] by [_____] (cmin).

2.2.5.2 Timber Bumpers and Fenders

Provide timber fenders and bumpers conforming to [Douglas Fir/Douglas Fir-Larch] [No. 2 southern yellow pine], structural grade, dressed surfacing, pressure treated with waterborne preservative. Cut, beveled, or bored fenders as required before pressure treatment. Ensure all waterborne

preservative treatment used is in accordance with AWPA Standard to the requirements of Use Category [UC4C for Fresh Water Use] [UC5C for Salt Water Use], except that chromated zinc chlorides, pentachlorophenol-ammoniacal systems, and alkyl ammonium compounds are not allowed. Ensure the producer brands each piece of treated lumber or timber in accordance with AWPA M6. It is the Contractor's responsibility to ensure the quality of treated wood products complies with this specification.

2.2.5.3 UHMW-PE Bumpers and Fenders

Provide composite section fender pads fabricated from ultra-high molecular weight polyethylene (UHMW-PE) plastic on top of a rubber or synthetic rubber backing. Ensure the final cross section complies with the dimensional requirements shown on the drawings. Ensure the lengths of fenders and bolting patterns also comply with the contract drawings. Cut and bevel the ultra-high molecular weight polyethylene material to the cross-sectional dimensions shown on the drawings. Provide bumpers and fenders that are yellow in color. Ensure the UHMW-PE is manufactured with a maximum of 50 percent regenerated material; and with a molecular weight of 3,000,000 to 5,000,000, in accordance with ASTM D4020, compression molded, stress relieved, and including an ultraviolet manufactured by Solidur Plastics Company, 200 Industrial Drive, Rte. 66 North, Delmont, PA 15626, or "ULTRA FEND" as manufactured by Ultra-Poly, Inc., 2926 South Steel Street, Tacoma, WA 98409 Physical characteristics of the UHMW-PE are required to meet the following:

a. Static Coefficient of Friction to Steel (Dry) - less than 0.25
b. Specific Gravity - greater than 0.92 (ASTM D792)
c. Water Absorption - do not show water absorption under long term immersion (ASTM D570)
d. Izod Impact - fender must exhibit a non-breaking condition under Izod type impact test (ASTM D256)
e. Tensile Strength - minimum break tensile strength of 4,000 psi (ASTM D638)
f. Hardness - 65-70 Durometer (ASTM D2240)

Provide extruded rubber backing materials compounded of natural or synthetic polyisoprene or a blend of both and ensure it contains reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers.

PHYSICAL TEST	TEST VALUE	SPECIFICATION
Tensile Strength	3,000 psi (min.)	ASTM D412
Elongation at Break	450 percent (min.)	ASTM D412
300 Percent Modulus	900 psi (min.)	ASTM D412
Durometer Hardness (Shore Type A)	60-70	ASTM D2240
Water Absorption	5 percent by Weight (Max.)	ASTM D471
Compression Set	30 percent (Max.)	ASTM D395

PHYSICAL TEST	TEST VALUE	SPECIFICATION
Tensile Strength (after aging 48 hr.)	80 percent (Min.)	ASTM D572

* Perform the "Water Absorption" test with 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, allow to cool to room temperature in air, and weigh the specimen. Record the weight to 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. Perform the immersion for 166 hours. Follow the method of attaching the rubber backing to the structure as indicated on the contract drawings.

]2.2.6 Asphalt Saturated Preformed Filler Strips

Comply with ASTM D1751.

2.2.7 Asphalt Cement

Comply with ASTM D3019.

2.2.8 Asphalt Mastic

Comply with SSPC PS 9.01.

2.3 MANUFACTURED UNITS

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

2.3.1 Bolts, Nuts and Washers

Ensure high-strength bolts, nuts, and washers conform to ASTM F3125/F3125M, Grade A325, [hot-dip galvanized]. Ensure bolts, nuts, studs, stud bolts and bolting materials other than high-strength conform to ASTM A307, Grade A, [hot-dip galvanized] or ASTM A320/A320M, [Ferritic Steel, Grade [_____]] [Austenitic Steel, Grade [_____], Class [_____]]. Use bolts M16 1/2 inch and larger that have hexagon heads. Ensure the finished shank of bolts is long enough to provide full bearing. Use washer with bolts that conform to the requirements specified in the applicable specification for bolts.

2.3.2 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

Ensure bolted connections conforms to 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 conforms to the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.6 Fabrications

2.4.6.1 Gate Leaf

Gate leaf is to be constructed from welded structural steel fabrication consisting of horizontal girders, [vertical beams,] [vertical girders,] intercostals, diaphragms, quoin post, gudgeon pin hood, operating strut connections, skin plate, and adjustable diagonals. Shop fabricate all gate leaves. The Contracting Officer's approval is required for any contractor proposed shop-fabrication of gate leaf in separate segments in order to facilitate handling and shipping. Show all such information on approved detail drawings. Such segments are required to permit easy field-assembly and be limited to as few as practicable to minimize the number of joints to be field-welded. Ensure the overall height of the gate leaf does not vary from the nominal dimension or differ from the mating gate leaf by more than 6 mm 1/4 inch. Ensure the surfaces of framing elements to which skin plates are to be welded do not vary from a true plane by more than 5 mm 3/16 inch. The outside surfaces of skin plates welded to framing members do not vary from a true plane by more than 5 mm. 3/16 inch. Locate splices in skin plates only where shown or approved. [In addition to welds specifically indicated on the drawings for nondestructive testing, conduct nondestructive testing on [_____] percent of the welds in the girders, gudgeon pin hood, verticals and skin plate of the gate leaf. The Contracting Officer will determine the location of these additional welds for testing.] Provide complete gate leaf with quoin and miter contact [blocks] [posts], miter guide assembly, pintle assembly, gudgeon anchorage, seal assembly, and other appurtenant components as required for complete installation, specified herein and shown.

2.4.6.2 Wall Quoin

Supply wall quoins fabricated from a welded structural steel frame with adjustable stainless steel base anchors and adjustable stainless steel quoin contact [block] [post].

2.4.6.3 Quoin and Miter Contact [Blocks] [Posts]

Supply quoin and miter contact [blocks] [posts] fabricated from stainless steel bars conforming to ASTM A276/A276M or ASTM A564/A564M. Make splices in contact [blocks] [posts] by an offset method so that there is no continuous joint across the [block] [post]. [Splices in gate leaf contact [block] [post] are only allowed to occur at the centerlines of horizontal girders.] Ensure splice locations match those of the opposing [block] [post]. Mill the contact faces of contact [blocks] [posts] at splices to assure watertight joints. Prove contact [blocks] [posts] with adjusting bolts as shown.

2.4.6.4 Pintle Assembly

Pintle assemblies consist of pintle socket, pintle, and pintle base as shown. Fabricate pintle socket from cast nickel alloys. Press fit pintle sockets with an aluminum bronze bushing with bearing surfaces finished truly hemispherical. Fabricate pintle from [cast alloy] [forged alloy] steel with bearing surfaces of corrosion-resisting steel. Provide pintle ball with a 0.4 micrometer 16 microinch finish and fit the ball into the bushing by scraping until uniform contact is attained over the entire bearing surface as determined by testing with carbon paper or other approved coloring. Match-mark the pintle ball with the bushing when fitted and so erected in the field. Fabricate the pintle base from cast steel. Drill and ream bolt holes for attaching pintle socket to gate leaf after the pintle socket is assembled with gate leaf. Connect pintle socket to the bottom of the lower girder web of the gate leaf with stainless steel bolts.

2.4.6.5 Gudgeon Anchorage

****
NOTE: The engineer is required to specify and select all ASTM A668 materials greater than 4 inches in thickness based on their specific grades and classes of materials (A through L). Note that material of classes G and higher are quenched and tempered and therefore difficult to weld.
****

Gudgeon anchorages are required to consist of gudgeon pin barrel, gudgeon anchorage links, gudgeon pin, and gudgeon embedded anchorage. Fabricate gudgeon pin barrel from welded [structural steel plates] [forged alloy steel plates conforming to ASTM A668/A668M] and fit them with a bronze bushing. Provide gudgeon anchorage links and gudgeon pins fabricated from forged alloy steel conforming to ASTM A668/A668M. Connect gudgeon anchorage links by a pin to the gudgeon embedded anchorage and provide a threaded section for adjustment of the gate leaf. Provide the threaded section with both right and left threads, a hexagonal sleeve nut with 13 mm 1/2 inch threads, and a jam nut with standard threads at each end of the sleeve nut. Fabricate the gudgeon embedded anchorage from a structural steel frame with end-restrained anchor bolts conforming to ASTM F3125/F3125M.

2.4.6.6 Seal Assemblies

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

2.4.6.7 Appurtenant Items

Sill assemblies, latches, bumpers fenders, seal plates and shapes, and other appurtenant items per the details specified and shown.

2.4.7 Shop Assembly

Shop assembly requirements for miter gates and appurtenant items are shown and specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Completely shop assemble miter gates and appurtenant items, unless otherwise approved by the Contracting Officer, to assure satisfactory field installation. Fit and bolt adjoining components together to facilitate field connections. Carefully preserve the match-marking of unassembled items until the items are assembled. Cover mating surfaces and machined surfaces with a rust preventative until assembly. Shop-welded 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, match-marked, and removed for shipment. Perform shop assembly and disassembly work in the presence of the Contracting Officer unless otherwise approved by the Contracting Officer; however, the presence of the Contracting Officer does not relieve the Contractor of any responsibility under this contract.

2.5 COMPONENTS

2.5.1 Cathodic Protection System

Conform to Section 26 42 19.10 CATHODIC PROTECTION SYSTEMS (IMPRESSED CURRENT) FOR LOCK MITER GATES.

2.5.2 Operating Machinery

Conform to 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

Perform tests, Inspections, and Verifications for materials the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.6.2 Testing of Rubber Seals

Test the fluorocarbon 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 fluorocarbon film and the rubber when subjected to the following loads:

THICKNESS OF FLUOROCARBON FILM	MACHINE METHOD AT 50 MM2 INCHES PER MINUTE	DEADWEIGHT METHOD
0.762 mm0.030 inch	13.6 kg per 25 mm30 pounds per inch width	13.6 kg per 25 mm30 pounds per inch width
1.524 mm0.060 inch	13.6 kg per 25 mm30 pounds per inch width	13.6 kg per 25 mm30 pounds 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 Pintle Assembly

Embed base anchors for the pintle assembly in first-pour concrete. Attach the pintle assembly base plate to base anchors, adjusted to the exact elevation and center-to-center distance shown, leveled, blocked rigidly to prevent displacement, and embedded in second-pour concrete. Allow the concrete to set 72 hours and to reach a minimum compressive strength of [_____] MPa psi before loading is applied. [Fill the space in the floating pintle base not occupied by the pintle shoe completely with sponge rubber before the gate leaf is set in place.]

3.1.3 Gudgeon Embedded Anchorage

Submit gudgeon embedded anchorage prestressing plan for approval prior to initiating the anchorage operations. Submit gudgeon embedded anchorage prestressing records prior to completion of the contract. Cover the gudgeon embedded anchorage, except for anchor bolts and horizontal anchor arms, with asphalt saturated preformed strips applied with asphalt cement prior to being embedded in concrete. Coat anchor bolts with asphalt mastic. Align, level and block rigidly into place the gudgeon embedded anchorage to prevent displacement before concrete is placed. Place concrete in a manner not to damage the preformed strips. Prestress anchor bolts after the concrete has attained the specified strength in accordance

with contract drawings and approved field installation drawings. Compile and submit a record of the gudgeon embedded anchorage prestressing operations immediately after completion of the prestressing operations.

3.1.4 Wall Quoin

Embed base anchors for the wall quoin in first-pour concrete. Attach the wall quoin to base anchors prior to setting the gate leaf in place. After the gate leaf is set in place, plumb and adjust the wall quoin in relation to the gate leaf quoin so as to provide for continuous contact between the sealing surfaces of the wall and gate leaf quoin contact [blocks] [posts] over the full height of the gate leaf. Make this adjustment almost entirely by moving the wall quoin so that the gap for the [epoxy] [zinc] filler behind the gate leaf quoin contact [block] [post] remains near the nominal dimension. After final adjustments have been made, the wall quoin firmly and place the second-pour concrete in the blockout.

3.1.5 Gate Leaf

Assemble gate leaf components not assembled in the shop in the field as required for installation. Coat the pintle ball with grease prior to setting the gate leaf in place. Tap pintle grease pipes into pintle bushing in correct register with bushing grease grooves. Flush grease pipes prior to connecting to bearings. Take all necessary precautions to avoid distortion of the gate leaf or any component parts. Exercise special care during installation to prevent any sag of the miter ends of the gate leaf due to compression of blocking or other causes. After the gate leaf has been set in place and the components of gudgeon anchorage are connected to the gate leaf, plumb the gate leaf and bring it into correct position by adjusting the sleeve nuts of the diagonals and the gudgeon anchorage links.

3.1.6 Diagonals

Attach gate leaf diagonals to the gate leaf after the leaf is set in place. Perform diagonals prestressing before the final adjustment of the quoin and miter contact [blocks] [post] are made. Prestress diagonals as specified, shown, and as approved on the Diagonals Prestressing Plan developed by the Contractor. Submit approved diagonal prestressing plan prior to initiating the prestressing operations. Submit diagonals prestressing records immediately after completion of the prestressing operations. Within the plan for prestressing the diagonals, describe the method of prestressing, including the materials, connections, rigging, anchorages, and stress measuring equipment. Compile a record of the prestressing operations consisting of the information indicated in the following table:

STRESS DATA TABLE					
Gate Leaf Location:				Date:	
	1	2	3	4	5
Diagonal	Strain Gage Initial	Readings Final	E (mm)(in.)	D (mm)(in.)	d (mm)(in.)
[_____]	[_____]	[_____]	[_____]	[_____]	[_____]

STRESS DATA TABLE					
[_____]	[_____]	[_____]	[_____]	[_____]	[_____]
[_____]	[_____]	[_____]	[_____]	[_____]	[_____]

1. Collect initial strain gage readings after slack is removed.

2. Collect final strain gage readings after prestressing is complete.

3. E is the total elongation over the full length of the diagonal, computed from the strain gage readings.

4. D is the prestress deflection of the leaf as shown on the drawings.

5. d is the field deflection of the leaf measured after completion of the prestress operation; it is the deflection when final strain gage readings are taken.

3.1.7 Gate Leaf Quoin and Miter Contact [Blocks] [Posts]

After the wall quoin has been adjusted and concreted in place and final adjustments made to the gudgeon anchorage links, adjust the gate leaf quoin and miter contact [blocks] [posts] to provide continuous contact over the full height of the gate leaf in the mitered position. After the gate leaf diagonals are prestressed and final adjustments of gate leaf quoin and miter contact [blocks] [posts] have been made with the gate leaf in the mitered position, swing the gate leaf out of miter and [epoxy] [zinc] pour filler behind the quoin and miter contact [blocks] [posts]. Prior to pouring of the filler, ensure the surfaces to receive the filler are cleaned free of dirt, rust, and other foreign materials. Coat the adjusting and holding bolts with grease or other bond breaker to prevent adherence of the filler.

3.1.7.1 Placing [Epoxy] [Zinc] Filler

[Conduct a field test to determine the indentation hardness of the epoxy filler compound prior to placement. The field test procedures are as follows:

a. Cast a 50 mm 2 inch cube sample of mixed epoxy filler compound in a mold and cure at room temperature (20 to 25 degrees C 70 to 80 degrees F) for 24 plus or minus 8 hours.

b. Remove from mold and cut sample to expose interior surface.

c. Sand exposed interior surfaces to remove saw marks and provide a smooth surface.

d. Using a Type D Durometer conforming to ASTM D2240, measure the hardness across the exposed interior surface, taking a minimum of three readings on each half of the sample. Care must be taken during the durometer reading to insure the spring loaded pin used to penetrate the surface is not in a depressed surface caused by either residual saw marks or an exposed air bubble. The average reading should be at least 85, with no individual reading below 82. Durometer readings which fall below the required minimum values is grounds for

the rejection of material.

Explicitly follow the manufacturer's instructions for placing the epoxy filler. Take special precautions to prevent leakage of the filler during placement. Ensure complete masses of all metals whose surface areas are to receive the epoxy filler have a temperature of 15 to 30 degrees C 60 to 90 degrees F. Keep the epoxy filler free from moisture or other foreign materials during mixing and placement and for at least 48 hours after placement.]

[Immediately preceding the pouring of the zinc filler, pre-heat the adjacent metal components to a temperature of 100 to 150 degrees C212 to 300 degrees F by an approved method which does not buckle the metal components. Pour the zinc filler at a temperature which insures that it completely fills all interstices. Maintain the pouring temperature of zinc filler between 430 and 480 degrees C 810 and 900 degrees F to minimize volatilization and oxidation of the zinc.]

3.1.7.2 Adjusting Contact [Blocks] [Posts]

After the [epoxy has set] [zinc has cooled], draw the quoin and miter contact [blocks] [posts] up against the filler by tightening the adjusting bolts. After the contact [blocks] [posts] are adjusted, swing the gate leaves into the mitered position without interference of the quoin contact [blocks] [posts] and ensure the gate leaf quoin contact [block] [post] makes tight contact with the wall quoin contact [block] [post].

3.1.8 Miter Guide

Install miter guide after the contact [blocks] [posts] have been properly set. Mount the guide bracket and roller bracket on gate leaves with leaves in the mitered position. Center the roller accurately in the saddle of the contact [blocks] [posts] and ensure it is in full contact with the [blocks] [posts]. Adjust the miter guide by adjusting the guide bracket and roller bracket so that the gap behind the contact [blocks] [posts] for the [epoxy] [zinc] filler is kept at the nominal dimension. Proper adjustment of the brackets results in either gate leaf to be mitered or opened without moving the other leaf. After final adjustments have been made, drill bolt holes in the brackets and gate leaves, bolt the brackets securely in place, and place [epoxy] [zinc] filler behind the contact [blocks] [posts].

3.1.9 Painting

Paint all exposed parts of gates and appurtenances except machined surfaces, corrosion-resistant 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.

3.1.10 Seal Assemblies

Install rubber seal assemblies after the embedded metal components have been concreted in place and the gate installation, including painting, completed. Securely fasten rubber seals to metal retainers. Before operating the gate(s), 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 is required to meet the same quality control requirements as shop-welded components.

3.3 SYSTEM START-UP

3.3.1 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. 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 per the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

-- End of Section --