UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025
****

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DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

SECTION 35 20 16.53

HYDRAULIC VERTICAL LIFT GATES

08/22

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC | **UFGS-35 20 16.53 (August 2022)**

Preparing Activity: USACE | **Superseding UFGS-35 20 16.53 (January 2008)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025

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SECTION 35 20 16.53

HYDRAULIC VERTICAL LIFT GATES
08/22

****

NOTE: This guide specification covers the requirements for the fabrication, assembly, delivery, and installation of vertical lift slide gate, vertical lift wheel gate, and vertical lift tractor gate and appurtenant items. This section was originally developed for USACE Civil Works projects.

Certain components of a Vertical Lift 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 (LUMP SUM 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 Furnish & Install Vertical Lift Side Gate & Appurtenances

****
NOTE: Alternate 1, Vertical Lift Slide Gate.
****

1.1.1.1 Payment

Payment is to be made for costs associated with furnishing and installing vertical lift slide gate and appurtenant items, which includes full compensation for the materials, fabrication, delivery, installation, and testing of vertical lift slide gate and appurtenant items including gate leaf, stem, stem guides, leaf nuts, leaf nut wrench, seal collars, frame, [bonnet,] [bonnet cover,] [pedestal,] [and] [base plate] for supporting operating machinery, [lock assembly,] [leaf springs,] [air vent liner,] and other appurtenances necessary for complete installation.

1.1.1.2 Unit of Measure

Unit of measure: lump sum.

1.1.2 Furnish Vertical Lift Side Gate & Appurtenances

****
NOTE: Alternate 2, Vertical Lift Slide Gate.
****

1.1.2.1 Payment

Payment is to be made for costs associated with furnishing vertical lift slide gate and appurtenant items, which includes full compensation for the materials, fabrication, and delivery, of vertical lift slide gate and appurtenant items including gate leaf, stem, stem guides, leaf nuts, leaf nut wrench, seal collars, frame, [bonnet,] [bonnet cover,] [pedestal,] [and] [base plate] for supporting operating machinery, [lock assembly,] [leaf springs,] [air vent liner,] and other appurtenances necessary for complete installation.

1.1.2.2 Unit of Measure

Unit of Measure: lump sum.

1.1.3 Install Vertical Lift Side Gate & Appurtenances

****
NOTE: Alternate 2, Vertical Lift Slide Gate.
****

1.1.3.1 Payment

Payment is to be made for costs associated with installing vertical lift slide gate and appurtenant items, which includes full compensation for the complete installation and testing of vertical lift slide gate and appurtenant items.

1.1.3.2 Unit of Measure

Unit of measure: lump sum.

1.1.4 Furnish & Install Vertical Lift Wheel Gate & Appurtenances

****
NOTE: Alternate 1, Vertical Lift Wheel Gate.
****

1.1.4.1 Payment

Payment is to be made for costs associated with furnishing and installing vertical lift wheel gate and appurtenant items, which includes full compensation for the materials, fabrication, delivery, installation, and testing of vertical lift wheel gate and appurtenant items including gate leaf, frame, guides, [lifting sling,] [lifting beam assembly,] [dogging devices,] [conduit liner,] [air vent,] and other appurtenances necessary for complete installation.

1.1.4.2 Unit of Measure

Unit of measure: lump sum.

1.1.5 Furnish Vertical Lift Wheel Gate & Appurtenances

****
NOTE: Alternate 2, Vertical Lift Wheel Gate.
****

1.1.5.1 Payment

Payment is to be made for costs associated with furnishing vertical lift wheel gate and appurtenant items, which includes full compensation for the materials, fabrication, and delivery of vertical lift wheel gate and appurtenant items including gate leaf, frame, guides, [lifting sling,] [lifting beam assembly,] [dogging devices,] [conduit liner,] [air vent,] and other appurtenances necessary for complete installation.

1.1.5.2 Unit of Measure

Unit of Measure: lump sum.

1.1.6 Install Vertical Lift Wheel Gate & Appurtenances

****
NOTE: Alternate 2, Vertical Lift Wheel Gate.
****

1.1.6.1 Payment

Payment is to be made for costs associated with installing vertical lift wheel gate and appurtenant items, which includes full compensation for the complete installation and testing of vertical lift wheel gate and appurtenant items.

1.1.6.2 Unit of Measure

Unit of measure: lump sum.

1.1.7 Furnish & Install Vertical Lift Tractor Gate & Appurtenances

****
NOTE: Alternate 1, Vertical Lift Tractor Gate.
****

1.1.7.1 Payment

Payment is to be made for costs associated with furnishing and installing vertical lift tractor gate and appurtenant items, which includes full compensation for the materials, fabrication, delivery, installation, and testing of vertical lift tractor gate and appurtenant items including gate leaf, frame, guides, [lifting sling,] [lifting beam assembly,] [dogging devices,] [conduit liner,] [air vent,] and other appurtenances necessary for complete installation.

1.1.7.2 Unit of Measure

Unit of measure: lump sum.

1.1.8 Furnish Vertical Lift Tractor Gate & Appurtenances

****
NOTE: Alternate 2, Vertical Lift Tractor Gate.
****

1.1.8.1 Payment

Payment is to be made for costs associated with furnishing vertical lift tractor gate and appurtenant items, which includes full compensation for the materials, fabrication, and delivery of vertical lift tractor gate and appurtenant items including gate leaf, frame, guides, [lifting sling,] [lifting beam assembly,] [dogging devices,] [conduit liner,] [air vent,] and other appurtenances necessary for complete installation.

1.1.8.2 Unit of Measure

Unit of Measure: lump sum.

1.1.9 Install Vertical Lift Tractor Gate & Appurtenances

****

NOTE: Alternate 2, Vertical Lift Tractor Gate.
****

1.1.9.1 Payment

Payment is to be made for costs associated with installing vertical lift tractor gate and appurtenant items, which includes full compensation for the complete installation and testing of vertical lift tractor gate and appurtenant items.

1.1.9.2 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	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,

	Welded and Seamless
ASTM A148/A148M	(2024) Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A240/A240M	(2024b) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276/A276M	(2024) 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	(2024a) 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 A709/A709M	(2024) Standard Specification for Structural Steel for Bridges
ASTM A992/A992M	(2022) Standard Specification for Structural Steel Shapes
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

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-410 (2022; Rev J) Wire Rope and Strand

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 and Air Force 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.

****

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. Submittals not having a "G" or "S" classification are 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

SD-06 Test Reports

Tests, Inspections, and Verifications

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Welders and Welding Operators

Ensure all qualifications of welders and welding operators conforms 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.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Detail Drawings

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

2.1.1.1 Fabrication Drawings

Ensure fabrication drawings show 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

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

2.1.1.3 Delivery Drawings

Ensure delivery drawings provide descriptions of methods of delivering components to the site, including details for supporting fabricated components during shipping to prevent distortion or other damages.

2.1.1.4 Field Installation Drawings

****
NOTE: If zinc filler is not specified, delete requirements for procedures and equipment for it.
****

Ensure field installation drawings provide a detailed description of the field installation procedures. Include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; plan for prestressing gate leaf diagonals, to include 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 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].

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 to 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 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.

]2.3 MANUFACTURED UNITS

Ensure that bolts, nuts, washers, screws and other manufactured units conform with the requirements as shown and as specified 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 [_____]]. 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. Ensure washers for use with bolts conform to the requirements specified in the applicable specification for bolts.

2.3.2 Screws

Provide screws of the type indicated.

2.3.3 Sheaves

Provide sheaves of cast steel conforming to ASTM A27/A27M, sized for the wire rope used.

2.3.4 Wire Rope

Provide wire rope conforming to FS RR-W-410, Type [_____], Class [_____], Construction [_____], [wire size,] [strand seizing] as indicated.

2.3.5 Wheels

Provide wheels that are short hub or long hub, rigid type, heavy duty steel casters fabricated with steel castings conforming to ASTM A148/A148M. Provide wheels of the size and load capacity shown. Provide wheel with lubrication fittings, roller bearings, and removable axle or shaft. Machine-finish wheel treads as shown. Unless otherwise specified or shown, provide stainless steel shafts for wheels conforming to ASTM A276/A276M, UNS S 30400.

2.4 FABRICATION

2.4.1 Structural Fabrication

Ensure structural fabrication conforms to the requirements as shown and specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Provide dimensional tolerances as specified and as shown. Splice only at locations where shown. 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 to be straightened by methods which will not damage the material. Press-fit 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 conform 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 conform with the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.6 Operating Machinery

****

NOTE: Specify appropriate section for vertical lift gate operating machinery.

****

Conform operating machinery to Section [_____].

2.4.7 Slide Gate Leaf

Provide slide gate leaves constructed of single-component structural fabrication. Shop fabricate slide gates and provide complete with gate stem, stem guides, leaf nut, leaf nut spanner wrench, bar seals, seal collars, [lock assembly,] [leaf springs,] and other appurtenant items as required for installation. Ensure that surfaces of leaf framing elements to which skin plates are to be welded do not vary from a true plane by more than\ ^2 mm 1/16 inch to provide uniform bearing. Ensure the outside surfaces of skin plates welded to framing elements do not vary from a true plane by more than 2 mm 1/16 inch. Locate splices in skin plates only

where shown. Ensure the overall width and height of the fabricated gate leaf does not vary from the respective dimensions shown by more than 2 mm 1/16 inch. Stress-relieve gate leaves prior to the attachment of bar seals. Machine surfaces where bar seals are attached accurately to provide uniform bearing for the full contact dimensions. Butt the top and side bar seals together firmly at the corners. Ensure the ends of side bar seals are flush with the bottom seating surface of the gate leaf. Perform final machining of bar seals after they are attached to the gate leaf. Machine the bottom seat of the gate leaf for a tight fit with the gate frame sill.

2.4.8 Slide Gate Frame and Bonnet

****
NOTE: Edit this paragraph to fit the project.
****

Shop fabricate the slide gate frame and bonnet. Ensure the guiding and seal surfaces of slide gate frame and bonnet are in a true vertical plane and are machined finished. Unmachined surfaces exposed to water flow are required to match at joints between component parts, and are not depart from true planes shown by more than 2 mm 1/16 inch and are to be free of offsets or irregularities greater than 2 mm 1/16 inch. Grind allowable offsets or irregularities less than 2 mm 1/16 inch to a bevel of not greater than one on twenty-four. Machine the bottom seat of the gate leaf for a tight fit with the gate frame sill. Ensure the gate frame and bonnet are stress relieved prior to the attachment of bar seals. Accurately machine surfaces where bar seals are attached to provide uniform bearing for the full contact dimensions. Butt top, side, and invert bar seals firmly together at the corners. Perform final machining of bar seals after they are attached to the gate frame and bonnet. Pour babbit in the gate frame sill and peen before machining the frame. When machining the gate frame sill, ensure the tool travel is parallel to the long dimension of the babbit.

2.4.9 Slide Gate Bonnet Cover, Pedestal and Base Plate

****
NOTE: Edit this paragraph to fit the project.
****

Accurately machine the flanges of the bonnet cover, pedestal and base plate for the supporting the operating machinery for the slide gate and drill to match mating flanges and provide the required true alignment. Coat unmachined oil-contacting surfaces of bonnet cover and pedestal with alkyd resin as specified for the unmachined oil-contacting surfaces of hydraulic cylinder heads. Base plate dimensions may be altered to fit the operating machinery furnished, provided the basic configuration, plate thickness, and number and sizes of fasteners are equal to that shown and the altered dimensions are approved.

2.4.10 Wheel Gate Leaf

****
NOTE: Delete first sentence if not applicable for the project.
****

Provide wheel gate leaves of single-component structural fabrication.

Ensure wheel gate leaves are shop fabricated and are provided complete with lifting brackets, wheel assemblies, seal assemblies, [guide shoes,] [plates,] [dogging brackets,] and other appurtenant items as required for installation and proper operation. Check the design center of gravity of the gate leaf prior to fabrication and notify the Contracting Officer if an unreasonable amount of counter-weighting is required to attain the center of gravity as designed. Ensure surfaces of leaf framing elements to which skin plates are to be welded do not vary from a true plane by more than 2 mm 1/16 inch to provide uniform bearing. Ensure the outside surfaces of skin plates welded to framing elements do not vary from a true plane by more than 2 mm 1/16 inch. Locate splices in skin plates only where shown. Ensure the overall width and height of the fabricated gate leaf does not vary from the respective dimensions shown by more than 2 mm 1/16 inch. Stress relieve the gate leaves prior to the attachment of seal assemblies and other appurtenant items.

2.4.10.1 Wheel Gate Leaf Lifting Brackets

Coordinate the fabrication details of wheel gate leaf lifting brackets closely with the details of the [lifting sling] [lifting hoist] [engaging and disengaging mechanism of the lifting beam assembly] to assure proper operation.

2.4.10.2 Wheel Gate Leaf Wheel Assembly

Provide wheel assemblies from a manufacturer regularly engaged in the manufacture of such products. Provide each wheel assembly complete with wheel, shaft, roller bearing, lock washer, lock nut, bearing cover, seal housing, grease seal, seal retainer, shaft lock plate, lubrication fittings, fasteners, and other accessories as required for complete and proper installation. Provide wheel diameter and thickness shown without variation. Only change the dimensions and tolerances of other components as required for compatibility with the manufacturer's product.

2.4.10.3 Wheel Gate Leaf Seal Assembly

Provide seal assemblies consisting of rubber seals, stainless steel retainer and spacer bars, and fasteners. Provide rubber seals that are continuous over the full length. Accurately fit seals accurately fit and drill 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 to develop a minimum tensile strength of 50 percent of the unspliced seal, and place them only at locations shown. Vulcanizing of splices is only allowed to be done in the shop. Locate the 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 the surfaces of finished splices are smooth and free of irregularities. Field splice stainless steel retainer bars only where shown and machine finish them after splicing.

2.4.11 Wheel Gate Frame and Guides

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NOTE: Delete last sentence if not applicable to the project.
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Ensure the exposed unmachined surfaces of wheel gate frame and guides match at joints between component parts, do not depart from true planes

shown by more than 2 mm 1/16 inch, and are free of offsets or irregularities greater than 2 mm 1/16 inch. Grind allowable offsets or irregularities less than 2 mm 1/16 inch to a bevel of not greater than one on twenty-four. Accurately machine surfaces of frames and guides to receive seal bars and wheel track bars to provide uniform bearing for the full contact dimensions. Butt seal bars firmly together at corners. Machine bearing surfaces of wheel track bars and sealing surfaces of seal bars to the tolerances shown to provide uniform bearing and sealing at all points of contact. Perform the final machining of seal bars and wheel track bars after they are attached to the gate frame and guides. Locate the anchor bolt holes for gate frame and guides accurately using Government-furnished templates which provide the installation location of anchor bolts.

2.4.12 Wheel Gate Lifting Sling

Provide wheel gate lifting sling made of wire rope with thimble and socket fittings attached to the wire rope in a manner that develops the full strength of the wire rope.

2.4.13 Wheel Gate Lifting Beam Assembly

Fabricate the wheel gate lifting beam assembly as shown for automatic engaging and disengaging with the lifting brackets of the gate leaf. Stress relieve the lifting beam prior to final machining and attachment of the roller and counterweight assemblies.

2.4.14 Tractor Gate Leaf

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NOTE: Delete first sentence if not applicable for the project.
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Fabricate the tractor gate leaf as a single-component structure. Shop fabricate the tractor gate leaf and provide complete with roller train assemblies, lifting brackets, seal assemblies, guide [shoes,] [plates,] [dogging brackets,] [pier guides,] [pier ties,] and other appurtenant items as required for installation and proper operation. Check the design center of gravity of the gate leaf prior to fabrication and give notification if an unreasonable amount of counterweighting is required to attain the center of gravity as designed. Ensure the surfaces of leaf framing elements to which skin plates are to be welded do not vary from a true plane by more than 2 mm 1/16 inch to provide uniform bearing. Ensure the outside surfaces of skin plates welded to framing elements do not vary from a true plane by more than 2 mm1/16 inch. Locate splices in skin plates only where shown. Ensure the overall width and height of the fabricated gate leaf does not vary from the respective dimensions shown by more than 2 mm 1/16 inch. Stress relieve the gate leaf prior to the attachment of seal assemblies and other appurtenant items.

2.4.14.1 Tractor Gate Leaf Lifting Brackets

Coordinate the fabrication details of tractor gate leaf lifting brackets closely with the details of the [lifting sling] [lifting hoist] [engaging and disengaging mechanism of the lifting beam assembly] to assure proper operation.

2.4.14.2 Tractor Gate Leaf Roller Train Assemblies

Provide roller train assemblies consisting of roller guides, track plates, roller train, and roller train cover. Provide adjustable roller guides that are removable without dismantling the roller train. Provide turned bolts, jack screws, shims for mounting and adjusting roller guides, and cap screws for attaching track plates as shown. Attach track plates to the gate leaf so that the side faces of the track plates are parallel to a vertical plane within 2 mm 1/16 inch. Machine finish the track surfaces of track plates to a plane parallel to a common plane within 2 mm 1/16 inch after being attached to the gate leaf. Provide roller train complete with pins, link bars, retaining rings, and other appurtenances as shown and as required for proper installation and operation.

2.4.14.3 Tractor Gate Leaf Guide Shoes

Attach guide shoes to the gate leaf for drilling and reaming for bolting. Locate the guide shoes accurately on the gate leaf in a true vertical plane with each other in the upstream-downstream direction. Lines passing through face of guide shoes on each side of leaf are required to be parallel within 2 mm 1/16 inch.

2.4.14.4 Tractor Gate Leaf Seal Assemblies

Provide seal assemblies consisting of rubber seals, stainless steel retainer and spacer bars, and fasteners. Provide rubber seals continuous over the full length that are accurately fitted and drilled for proper installation. Drill bolt holes in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals are required be fully molded, developing a minimum tensile strength of 50 percent of the unspliced seal, and occurring only at locations shown. Shop vulcanizing all splices. Locate the 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 the surfaces of finished splices are smooth and free of irregularities. Field splice stainless steel retainer bars only where shown and machine finish after splicing.

2.4.15 Tractor Gate Frame and Guides

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NOTE: Delete last sentence if not applicable for the project.
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Ensure exposed unmachined surfaces of tractor gate frame and guides match at joints between component parts, do not depart from true plane shown by more than 2 mm 1/16 inch, and are free of offsets or irregularities greater than 2 mm 1/16 in. Grind allowable offsets or irregularities less than 2 mm 1/16 inch to a bevel of not greater than one on twenty-four. Machine the surfaces of frames and guides to receive roller track plates and seal plates accurately to provide uniform bearing for the full contact dimensions. Butt seal plates firmly together at corners. Machine roller bearing surfaces of track plates and sealing surfaces of seal plates to the tolerances shown to provide uniform bearing and sealing at all points of contact. Perform final machining of track plates and seal plates after they are attached to the gate frame and guides. Locate the anchor bolt holes for gate frame and guides accurately using Government furnished templates which provide the installation location of anchor bolts.

2.4.16 Tractor Gate Lifting Sling

Provide tractor gate lifting sling made of wire rope with thimble and socket fittings attached to the wire rope in a manner that develops the full strength of the wire rope.

2.4.17 Tractor Gate Lifting Beam Assembly

Fabricate the tractor gate lifting beam assembly as shown for automatic engaging and disengaging with the lifting brackets of the gate leaf. Stress relieve the lifting beam prior to final machining and attachment of the roller and counterweight assemblies.

2.4.18 Appurtenant Items

Ensure the fabrication requirements for [air vents,] [air vent liner,] [conduit liner,] [dogging devices,] [pier tie anchors,] [gate leaf pier guides,] and other appurtenant items conform to the details shown.

2.4.19 Shop Assembly

Provide shop assembly requirements for gate, gate frame and appurtenant items as shown and as specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Assemble gate, frame, guides, and appurtenant items completely in the shop to assure satisfactory field installation. Carefully preserve the match-marking of unassembled components until the components are assembled. Provide adequate support during assembly to maintain components within 2 mm 1/16 inch of actual installation planes. Coat mating surfaces and machined surfaces with a rust preventive coating until assembled. Thinly coat other connecting surfaces which are not required to be disassembled for shipment with an approved rust preventive coating before being joined. Fit and bolt adjoining components together to facilitate field connections. Deliver shop assembled components assembled, if practically permitted by shipping and field installation conditions. Shop weld assembled components in their final positions as much as delivery and field installation conditions allow. Perform shop assembly and disassembly work in the presence of the Contracting Officer unless otherwise approved. The presence of the Contracting Officer in no way relieves the Contractor of any responsibility under this contract.

2.4.19.1 Gate Leaf

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NOTE: This paragraph must be edited to fit the project.
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Shop assemble the gate leaf in the [vertical position] [and] [horizontal position with the skin side of the gate leaf facing down]. Include in the shop assembly the attachment of all accessories to the gate leaf. Lift the [wheel gate leaf] [and] [tractor gate leaf] by the lifting brackets and inspect for balance about the center of gravity after being shop assembled. If the gate leaf is out of plumb by more than 6 mm 1/4 inch in the total length in a vertical plane in the upstream-downstream direction, or by more than 2 mm 1/16 inch in the total width in a vertical plane perpendicular to the vertical plane in the upstream-downstream direction, balance it by counterweighting or some other method as approved at the Contractor's expense.

2.4.19.2 Wheel Assemblies

Support the gate leaf in the horizontal position for adjusting wheel assemblies so that the wheels of the attached wheel assemblies are free to rotate to allow the proper adjustment. Adjust attached wheel assemblies so that the wheels remain perpendicular to the gate leaf and the contact surfaces of the wheels on each side of the gate leaf are in a single plane within 0.127 mm 0.005 inch when rotated 360 degrees. Make the final adjustment of wheel assemblies after the gate leaf is assembled with the gate frame and guides in the horizontal position. Tap the top of each wheel to insure that the weight of the wheel assembly has caused the shaft to bear firmly on the supporting framing of the gate leaf. Adjust wheel assemblies so that the tolerance on the distance between the plane through the downstream faces of the wheels and the plane through the downstream machined surfaces of the side bar supports for the seal assemblies does not exceed 1 mm1/32 inch. After wheel assemblies have been adjusted, lock them in position by drilling the lock plate, support plate, and shaft and installing cap screws as shown. Lubricate the wheel assemblies after being locked in position with a lubricant that is suitable for underwater operation, equal to the lubricant recommended by the manufacturer of the wheel roller bearings, and as approved. Apply additional lubricant at regular intervals until final acceptance of the work.

2.4.19.3 Roller Train Assemblies

Mount roller trains on the track plates with the gate leaf in the vertical position. Adjust roller guides so that the roller trains are in alignment and can traverse freely without binding and with a maximum sag of 19 mm 3/4 inch at the bottom. After the roller trains are mounted, maintain the gate leaf in a vertical position unless the roller trains are securely restrained from sagging.

2.4.19.4 Guide Shoes

Drill and ream guide shoes for bolting to the gate leaf while attached to the gate leaf. Locate the guide shoes accurately on the gate leaf in a true plane with each other in the upstream-downstream direction and parallel to the plane established by the downstream machined surfaces of the side bar supports for the seal assemblies. Provide shims as required.

2.4.19.5 Seal Assemblies

Attach seal assemblies to the gate leaf during shop assembly and remove for shipment. Fit the rubber seals of the assemblies accurately drill to match the seal retainers, match mark, and remove for shipment.

2.4.19.6 Lifting Beam Assembly

Shop assemble the lifting beam assembly in the sequence and manner shown. Check the balance of the completed assembly by lifting the assembly by the pick-up pin. If the lifting beam is out of true horizontal by more than 10 mm 3/8 inch, use counterweighting or some other method approved to balance the assembly at the Contractor's expense.

2.4.19.7 Dogging Devices

Shop assemble dogging devices completely. Drill pin holes in base plates and dogs with these components in assembly.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

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

2.5.1 General

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

2.5.2 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 Gate Frame and Guides

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NOTE: This paragraph must be edited to fit the project.

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Connect gate frame and guides to embedded anchors, align, and rigidly block in place prior to the placement of second-pour concrete. Use the sealing surfaces of the slide gate frame seal bars as the reference plane for the installation alignment. Alignment by using two theoretical control planes described as control plane "A" and control plane "B". Control plane "A" is a vertical plane that is normal to the water passageway and is located at the sealing surface of the gate frame seal bars. Control plane "B" is a vertical plane that is parallel to the water passageway and is located at the centerline of the water passageway. Align the gate frame to within 0.381 mm 0.015 inch of control planes "A" and "B". Use a taut piano wire and an electric micrometer or some other approved method to measure the vertical alignment tolerances. Align the [wheel gate] [and] [roller gate] frame and guides such that planes through the bearing surfaces of track plates and the sealing surfaces of seal plates align to within 2 mm 1/16 inch of the alignment shown. Test gate frame and guides for proper alignment and clearances prior to being embedded in concrete by lowering and raising the gate leaf through the full operating range.

3.1.3 Gate Leaf

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NOTE: Delete reference to rubber seals if not applicable for the project.

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Assemble gate leaf completely, including the attachment of all components and accessories, prior to being placed in the gate frame. Take all necessary precautions to avoid distortion of the gate leaf and attached components during installation. Fasten rubber seals securely to metal retainers. Before operating the gate, apply a suitable lubricant to the rubber seal rubbing plates to protect the rubber.

3.1.4 Operating Machinery

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NOTE: This paragraph must be edited to fit the project.

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Position and align the operating machinery for the gate assembly and supporting components, including [bonnet,] [bonnet cover,] [pedestal,] [and] [base plate], to the installed location of the gate frame and guides and anchored in place. Project the location of the slide gate stem to the sill and scribe on the sill of the installed gate frame to serve as a reference point for the alignment of operating machinery and supporting components. Align operating machinery and components to within 0.762 mm 0.030 inch of the reference point. Bolt an alignment template, prior to being embedded in concrete, to the [bonnet,] [bonnet cover,] marked, and drilled to match the exact center point of the gate stem.

3.1.5 Concrete and Concrete Grout Placement

Perform the embedment of the gate frame and other components in concrete in an approved manner to fill all voids, secure anchorage, prevent

seepage, and provide uniform finish surfaces. After embedment concrete has cured for at least 7 days, fill voids around embedded components by pumping concrete grout around the components. After the pumped grout has cured for at least 7 days, use hammer blows to the components to detect any remaining voids. Where remaining voids are located, drill 25 mm 1 inch diameter grout holes in the components and fill the voids pressure grouting through the grout holes. Plug the grout holes in the components by welding and grinding flush.

3.1.6 Painting

Paint exposed parts of the gate and appurtenance components, except machined surfaces, corrosion-resistant surfaces, surfaces of anchorages embedded in concrete, and other specified surfaces, as specified in Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES.

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 Operation

After the gate assembly has been installed, including operating machinery, the Contracting Officer will examine the complete system for final acceptance. Furnish all operation and test results to the Contracting Officer. The assembly will be examined first to determine whether or not the workmanship conforms to the specification requirements. Operate the gate throughout its full operating range a sufficient number of times to demonstrate proper operation. [Operate the gate from the remote control vault and the control panel in the control tower.] [Operation of hydraulic cylinders by use of compressed air will not be permitted.] Conduct the initial operation of the gate assembly in the dry. [With the gate leaf in the seated position and uniformly blocked so that the [wheels] [rollers] are in uniform contact with the track plates, check the rubber seals to ensure that they are uniformly compressed against the seal plates.] [Test the gate lock assembly by destructing one set of lock pins by inserting one set of pins in the lock position, permitting the weight of the gate leaf to rest on the pins, and using the hydraulic pressure system to break the pins by applying pressure to the top of the hydraulic cylinder. Adjust the pressure at the pressure reducing valve to its lowest setting and gradually increase it until the pins fail. Record the pressure reading at failure of the lock pins in the operation and test report. After completion of the test, replace the broken pins with new ones.] Conduct the second trial operation and testing of the gate assembly with the reservoir normal operating pool hydrostatic pressure. Ensure the workmanship in the fabrication and installation of the gate assembly causes the gate leaf to form a watertight barrier when lowered to the seated position. Make adjustments to the operation and control apparatus until all components function as required. Inspect the [lifting beam assembly,] [lifting sling,] [dogging devices,] and other appurtenances to assure proper operation. Make any and all required repairs or replacements to correct defects, as determined by the Contracting Officer, at no additional cost to the Government. Repeat the trial operation and testing after defects are corrected.

3.4 PROTECTION

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

-- End of Section --