UNIFIED FACILITIES GUIDE SPECIFICATIONS

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

SECTION 35 20 16.53

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-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA | **UFGS-35 20 16.53 (January 2008)**

Preparing Activity: USACE | **Superseding UFGS-35 20 16.53 (April 2006)**

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References are in agreement with UMRL dated January 2021

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SECTION 35 20 16.53

VERTICAL LIFT GATES
01/08

****

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.

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 LUMP SUM 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 Gate & Appurtenances

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

1.1.1.1 Payment

Payment will 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 Gate & Appurtenances

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

1.1.2.1 Payment

Payment will 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 Gate & Appurtenances

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

1.1.3.1 Payment

Payment will 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 Wheel Gate & Appurtenances

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

1.1.4.1 Payment

Payment will 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 Wheel Gate & Appurtenances

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

1.1.5.1 Payment

Payment will 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 Wheel Gate & Appurtenances

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

1.1.6.1 Payment

Payment will 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 Tractor Gate & Appurtenances

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

1.1.7.1 Payment

Payment will 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 Tractor Gate & Appurtenances

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

1.1.8.1 Payment

Payment will 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 Tractor Gate & Appurtenances

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

1.1.9.1 Payment

Payment will 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.

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A148/A148M	(2020; E 2020) Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A240/A240M	(2020) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A320/A320M	(2017b) Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service

ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A490	(2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A490M	(2014a) Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A564/A564M	(2019) Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A572/A572M	(2018) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	(2019) Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM D395	(2016; E 2017) Standard Test Methods for Rubber Property - Compression Set
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D413	(1998; R 2017) Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D572	(2004; R 2019) Rubber Deterioration by Heat and Oxygen
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-410	(2020; 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, Air Force, and NASA projects.

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

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

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

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

SD-03 Product Data

Materials

Welding; G[, [_____]]

Materials

SD-06 Test Reports

Tests, Inspections, and Verifications

Acceptance Trial Operation and Test

1.4 QUALIFICATION OF WELDERS AND WELDING OPERATORS

Qualification of welders and welding operators shall conform to the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 General

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

1.5.2 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. Rubber seals shall not be distorted during handling.

1.6 WARRANTY

****

NOTE: Designated appurtenances of the gate assembly may be guaranteed for a minimum period of 1 year from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier, against defective materials and workmanship. Such guarantees will require the Contractor to furnish and install new replacement parts immediately upon receipt of notice from the Government of the failure of any part of the guaranteed items during the warranty period. These warranty requirements will be covered in the CONTRACT CLAUSES and this paragraph should be deleted from this section of the specifications.

****

[_____]

PART 2 PRODUCTS

2.1 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. Furnish materials orders, material lists and material shipping bills conforming with the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.1.1 Metals

Structural steel, monel, [babbit,] steel forgings, steel castings, stainless steel, bronze, aluminum bronze, brass and other metal materials used for fabrication shall conform to the requirements as shown and as specified herein and in Section 05 50 15 CIVIL WORKS FABRICATIONS.

2.1.1.1 Structural Steel

Structural steel shall conform to ASTM A36/A36M.

2.1.1.2 Structural Steel Plates

Structural steel plates shall conform to [ASTM A36/A36M] [ASTM A572/A572M, Grade 50] [ASTM A588/A588M, Grade [_____]].

2.1.1.3 Steel Pipe

Steel pipe shall 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.

2.1.1.4 Stainless Steel Bars and Shapes

Stainless steel bars and shapes shall 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.

2.1.1.5 Stainless Steel Plate, Sheet, and Strip

Stainless steel plate, sheet, and strip shall conform to ASTM A240/A240M, UNS [S 20910,] [S 30400,] [S 40500,] [S 41008]. Plate finish shall be hot-rolled, annealed or heat-treated, and blast-cleaned or pickled. Sheet and strip finish shall be No. 1.

2.1.2 Rubber Seals

****
NOTE: If fluorocarbon (Teflon) clad seals are not used, omit paragraphs FABRICATION OF RUBBER SEALS AND TESTING OF RUBBER SEALS.
****

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

2.1.2.1 Physical Characteristics

Physical characteristics of the seals shall meet the following requirements:

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
Tensile Strength	17.2 MPa2500 psi (min.)	ASTM D412
Elongation at Break	450 percent (min.)	ASTM D412
300 percent	6.2 MPa900 psi (min.)	ASTM D412
Durometer Hardness (Shore Type A)	60 to 70	ASTM D2240
*Water Absorption	5 percent by weight (max.)	ASTM D471
Compression Set	30 percent (max.)	ASTM D395
Tensile Strength (after aging 48 hrs)	80 percent of tensile strength (min.)	ASTM D572

The "Water Absorption" test shall be performed with distilled water. The washed specimen shall be blotted dry with filter paper or other absorbent material and suspended by means of small glass rods in the oven at a temperature of 70 degrees C plus or minus 2 degrees for 22 hours plus or minus 1/4 hour. The specimen shall be removed, allowed to cool to room temperature in air, and weighed. The weight shall be recorded to the nearest 1 mg as M subscript 1 (M subscript 1 is defined in ASTM D471). The immersion temperature shall be 70 degrees C plus or minus 1 degree and the duration of immersion shall be 166 hours.

2.1.2.2 Fabrication of Rubber Seals

Rubber seals shall have a fluorocarbon film vulcanized and bonded to the sealing surface of the bulb. The film shall be [0.726] [1.524] mm[0.030] [0.060] inches thick Huntington Abrasion Resistant Fluorocarbon Film No. 4508, or equal, and shall have the following physical properties:

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

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

2.2 MANUFACTURED UNITS

Bolts, nuts, washers, screws and other manufactured units shall conform with the requirements as shown and as specified and in Section 05 50 15 CIVIL WORKS FABRICATIONS.

2.2.1 Bolts, Nuts and Washers

[High-strength bolts, nuts, and washers shall conform to ASTM A325M

ASTM A325, Type [_____], [hot-dip galvanized] [_____] or ASTM A490M ASTM A490, Type [_____].] [Bolts, nuts, studs, stud bolts and bolting materials other than high-strength shall conform to ASTM A307, Grade A, [hot-dip galvanized] [_____] or ASTM A320/A320M, [Ferritic Steel, Grade [_____]] [Austenitic Steel, Grade [_____], Class [_____]].] Bolts 13 mm 1/2 inch and larger shall have hexagon heads. The finished shank of bolts shall be long enough to provide full bearing. Washers for use with bolts shall conform to the requirements specified in the applicable specification for bolts.

2.2.2 Screws

Screws shall be of the type indicated.

2.2.3 Sheaves

Sheaves shall be of cast steel conforming to ASTM A27/A27M, sized for the wire rope used.

2.2.4 Wire Rope

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

2.2.5 Wheels

Wheels shall be short hub or long hub, rigid type, heavy duty steel casters fabricated with steel castings conforming to ASTM A148/A148M. Wheels shall be of the size and load capacity shown. Wheel shall be provided with lubrication fittings, roller bearings, and removable axle or shaft. Wheel treads shall be machined-finished as shown. Unless otherwise specified or shown, shafts for wheels shall be stainless steel conforming to ASTM A276/A276M, UNS S 30400.

2.3 FABRICATION

2.3.1 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.

2.3.1.1 Fabrication Drawings

Fabrication drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

2.3.1.2 Shop Assembly Drawings

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

2.3.1.3 Delivery Drawings

Delivery drawings shall provide descriptions of methods of delivering components to the site, including details for supporting fabricated

components during shipping to prevent distortion or other damages.

2.3.1.4 Field Installation Drawings

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

Field installation drawings shall provide a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; plan for prestressing gate leaf diagonals, which shall include descriptions of connections, riggings, anchorages, and measuring equipment; 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.

2.3.2 Structural Fabrication

****
NOTE: Delete reference to cathodic protection if not required for project.
****

Structural fabrication shall conform to the requirements as shown and specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Dimensional tolerances shall be as specified and as shown. Splices shall occur only where shown. Pin holes shall be bored in components after welding, straightening, stress-relieving, and threading operations are completed. Brackets, eye bar sections, and other components requiring straightening shall be straightened by methods which will not damage the material. Bushings shall be press-fitted with supporting components. Bolt connections, lugs, clips, or other pick-up assembly devices shall be provided for components as shown and required for proper assembly and installation. Provisions shall be made for the installation of cathodic protection system devices and other appurtenances as required.

2.3.2.1 Welding

****
NOTE: List applicable welds requiring radiographic examination. Delete reference to stress-relieving if not applicable for the project.
****

Submit schedules of welding procedures for structural steel conforming with the requirements specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Welds shall be of the type shown and approved detail drawings. Radiographic examination is required on the major shop and field welds of the type and location indicated 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 situated where radiographic examination is not feasible may be examined, with written approval, by dye penetrant, magnetic particle tests, or ultrasonic tests. Components shall be stress-relief heat

treated after welding where shown. Stress-relieving of components shall be performed prior to the attachment of miscellaneous appurtenances.

2.3.2.2 Bolted Connections

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

2.3.2.3 Machine Work

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

2.3.2.4 Miscellaneous Provisions

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

2.3.3 Slide Gate Leaf

Slide gate leaf shall be of single-component structural fabrication. Slide gate shall be shop fabricated and shall be provided 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. Surfaces of leaf framing elements to which skin plates are to be welded shall not vary from a true plane by more than\ ^2 mm 1/16 inch to provide uniform bearing. The outside surfaces of skin plates welded to framing elements shall not vary from a true plane by more than 2 mm 1/16 inch. Splices in skin plates shall be located only where shown. The overall width and height of the fabricated gate leaf shall not vary from the respective dimensions shown by more than 2 mm1/16 inch. Gate leaf shall be stress-relieved prior to the attachment of bar seals. Surfaces where bar seals are attached shall be accurately machined to provide uniform bearing for the full contact dimensions. Top and side bar seals shall be firmly butted together at the corners. The ends of side bar seals shall be flush with the bottom seating surface of the gate leaf. Final machining of bar seals shall be performed after they are attached to the gate leaf. The bottom seat of the gate leaf shall be machined for a tight fit with the gate frame sill.

2.3.4 Slide Gate Frame and Bonnet

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

Slide gate frame and bonnet shall be shop fabricated. Guiding and seal surfaces of slide gate frame and bonnet shall be in a true vertical plane and shall be machined finished. Unmachined surfaces exposed to water flow shall match at joints between component parts, shall not depart from true planes shown by more than 2 mm 1/16 inch and shall be free of offsets or irregularities greater than 2 mm 1/16 inch. Allowable offsets or irregularities less than 2 mm 1/16 inch shall be ground to a bevel of not greater than one on twenty-four. The bottom seat of the gate leaf shall be machined for a tight fit with the gate frame sill. Gate frame and bonnet shall be stress relieved prior to the attachment of bar seals. Surfaces where bar seals are attached shall be accurately machined to provide uniform bearing for the full contact dimensions. Top, side, and

invert bar seals shall be firmly butted together at the corners. Final machining of bar seals shall be performed after they are attached to the gate frame and bonnet. Babbit shall be poured in the gate frame sill and peened before machining the frame. When machining the gate frame sill, the tool travel shall be parallel to the long dimension of the babbit.

2.3.5 Slide Gate Bonnet Cover, Pedestal and Base Plate

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NOTE: Edit this paragraph to fit the project.
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The flanges of the bonnet cover, pedestal and base plate for the supporting the operating machinery for the slide gate shall be accurately machined and drilled to match mating flanges and provide the required true alignment. Unmachined oil-contacting surfaces of bonnet cover and pedestal shall be coated 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.

2.3.6 Wheel Gate Leaf

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NOTE: Delete first sentence if not applicable for the project.
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Wheel gate leaf shall be of single-component structural fabrication. Wheel gate leaf shall be shop fabricated and shall be 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. Surfaces of leaf framing elements to which skin plates are to be welded shall not vary from a true plane by more than 2 mm 1/16 inch to provide uniform bearing. The outside surfaces of skin plates welded to framing elements shall not vary from a true plane by more than 2 mm 1/16 inch. Splices in skin plates shall be located only where shown. The overall width and height of the fabricated gate leaf shall not vary from the respective dimensions shown by more than 2 mm 1/16 inch. Gate leaf shall be stress relieved prior to the attachment of seal assemblies and other appurtenant items.

2.3.6.1 Wheel Gate Leaf Lifting Brackets

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

2.3.6.2 Wheel Gate Leaf Wheel Assembly

Wheel assemblies shall be products of a manufacturer regularly engaged in the manufacture of such products. Each wheel assembly shall be provided 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. Wheel diameter and thickness shall not be changed from that shown. The dimensions and tolerances of other components may be changed as required for compatibility with the manufacturer's product.

2.3.6.3 Wheel Gate Leaf Seal Assembly

Seal assemblies shall consist of rubber seals, stainless steel retainer and spacer bars, and fasteners. Rubber seals shall be continuous over the full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown. All vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Stainless steel retainer bars shall be field-spliced only where shown and machine finished after splicing.

2.3.7 Wheel Gate Frame and Guides

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NOTE: Delete last sentence if not applicable to the project.

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Exposed unmachined surfaces of wheel gate frame and guides shall match at joints between component parts, shall not depart from true planes shown by more than 2 mm 1/16 inch, and shall be free of offsets or irregularities greater than 2 mm 1/16 inch. Allowable offsets or irregularities less than 2 mm 1/16 inch shall be ground to a bevel of not greater than one on twenty-four. Surfaces of frames and guides to receive seal bars and wheel track bars shall be accurately machined to provide uniform bearing for the full contact dimensions. Seal bars shall be firmly butted together at corners. Bearing surfaces of wheel track bars and sealing surfaces of seal bars shall be machined to the tolerances shown to provide uniform bearing and sealing at all points of contact. Final machining of seal bars and wheel track bars shall be performed after they are attached to the gate frame and guides. Anchor bolt holes for gate frame and guides shall be accurately located using Government-furnished templates which provide the installation location of anchor bolts.

2.3.8 Wheel Gate Lifting Sling

Wheel gate lifting sling shall be 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.

2.3.9 Wheel Gate Lifting Beam Assembly

Wheel gate lifting beam assembly shall be fabricated as shown for automatic engaging and disengaging with the lifting brackets of the gate leaf. The lifting beam shall be stress relieved prior to final machining and attachment of the roller and counterweight assemblies.

2.3.10 Tractor Gate Leaf

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NOTE: Delete first sentence if not applicable for the project.
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Tractor gate leaf shall be of single-component structural fabrication. Tractor gate leaf shall be shop fabricated and shall be provided 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. Surfaces of leaf framing elements to which skin plates are to be welded shall not vary from a true plane by more than 2 mm 1/16 inch to provide uniform bearing. The outside surfaces of skin plates welded to framing elements shall not vary from a true plane by more than 2 mm1/16 inch. Splices in skin plates shall be located only where shown. The overall width and height of the fabricated gate leaf shall not vary from the respective dimensions shown by more than 2 mm 1/16 inch. Gate leaf shall be stress relieved prior to the attachment of seal assemblies and other appurtenant items.

2.3.10.1 Tractor Gate Leaf Lifting Brackets

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

2.3.10.2 Tractor Gate Leaf Roller Train Assemblies

Roller train assemblies shall consist of roller guides, track plates, roller train, and roller train cover. Roller guides shall be adjustable and removable without dismantling the roller train. Turned bolts, jack screws, shims for mounting and adjusting roller guides, and cap screws for attaching track plates shall be provided as shown. Track plates shall be attached 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. The track surfaces of track plates shall be machined finished to a plane parallel to a common plane within 2 mm 1/16 inch after being attached to the gate leaf. Roller train shall be provided complete with pins, link bars, retaining rings, and other appurtenances as shown and as required for proper installation and operation.

2.3.10.3 Tractor Gate Leaf Guide Shoes

Guide shoes shall be attached to the gate leaf for drilling and reaming for bolting. Guide shoes shall be accurately located 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 shall be parallel within 2 mm 1/16 inch.

2.3.10.4 Tractor Gate Leaf Seal Assemblies

Seal assemblies shall consist of rubber seals, stainless steel retainer and spacer bars, and fasteners. Rubber seals shall be continuous over the

full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown. Vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Stainless steel retainer bars shall be field spliced only where shown and machine finished after splicing.

2.3.11 Tractor Gate Frame and Guides

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NOTE: Delete last sentence if not applicable for the project.
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Exposed unmachined surfaces of tractor gate frame and guides shall match at joints between component parts, shall not depart from true plane shown by more than 2 mm 1/16 inch, and shall be free of offsets or irregularities greater than 2 mm 1/16 in. Allowable offsets or irregularities less than 2 mm 1/16 inch shall be ground to a bevel of not greater than one on twenty-four. Surfaces of frames and guides to receive roller track plates and seal plates shall be accurately machined to provide uniform bearing for the full contact dimensions. Seal plates shall be firmly butted together at corners. Roller bearing surfaces of track plates and sealing surfaces of seal plates shall be machined to the tolerances shown to provide uniform bearing and sealing at all points of contact. Final machining of track plates and seal plates shall be performed after they are attached to the gate frame and guides. Anchor bolt holes for gate frame and guides shall be accurately located using Government furnished templates which provide the installation location of anchor bolts.

2.3.12 Tractor Gate Lifting Sling

Tractor gate lifting sling shall be 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.

2.3.13 Tractor Gate Lifting Beam Assembly

Tractor gate lifting beam assembly shall be fabricated as shown for automatic engaging and disengaging with the lifting brackets of the gate leaf. The lifting beam shall be stress relieved prior to final machining and attachment of the roller and counterweight assemblies.

2.3.14 Appurtenant Items

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

2.3.15 Shop Assembly

Shop assembly requirements for gate, gate frame and appurtenant items shall be as shown and as specified and in Section 05 50 14 STRUCTURAL

METAL FABRICATIONS. Gate, frame, guides, and appurtenant items shall be assembled completely in the shop to assure satisfactory field installation. The matchmarking of unassembled components shall be carefully preserved until the components are assembled. Adequate support shall be provided during assembly to maintain components within 2 mm 1/16 inch of actual installation planes. Mating surfaces and machined surfaces shall be coated with a rust preventive coating until assembled. Other connecting surfaces which are not required to be disassembled for shipment shall be thinly coated with an approved rust preventive coating before being joined. Adjoining components shall be fitted and bolted together to facilitate field connections. Shop assembled components shall be delivered assembled, if practically permitted by shipping and field installation conditions. Assembled components shall be shop welded in their final positions as much as delivery and field installation conditions allow. Shop assembly and disassembly work shall be performed in the presence of the Contracting Officer unless otherwise approved. The presence of the Contracting Officer will not relieve the Contractor of any responsibility under this contract.

2.3.15.1 Gate Leaf

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

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Shop assembly of the gate leaf shall be in the [vertical position] [and] [horizontal position with the skin side of the gate leaf facing down]. Shop assembly shall include the attachment of all accessories to the gate leaf. The [wheel gate leaf] [and] [tractor gate leaf] shall be lifted by the lifting brackets and inspected 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, it shall be balanced by counterweighting or some other method as approved at the Contractor's expense.

2.3.15.2 Wheel Assemblies

The gate leaf shall be supported 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. Attached wheel assemblies shall be adjusted 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. The final adjustment of wheel assemblies shall be made after the gate leaf is assembled with the gate frame and guides in the horizontal position. The top of each wheel shall be tapped to insure that the weight of the wheel assembly has caused the shaft to bear firmly on the supporting framing of the gate leaf. Wheel assemblies shall then be adjusted 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 shall not exceed 1 mm1/32 inch. After wheel assemblies have been adjusted, they shall be locked in position by drilling the lock plate, support plate, and shaft and installing cap screws as shown. Wheel assemblies shall be lubricated 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. Additional lubricant shall be applied at regular intervals until final acceptance of the work.

2.3.15.3 Roller Train Assemblies

Roller trains shall be mounted on the track plates with the gate leaf in the vertical position. Roller guides shall be adjusted 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, the gate leaf shall be maintained in a vertical position unless the roller trains are securely restrained from sagging.

2.3.15.4 Guide Shoes

Guide shoes shall be drilled and reamed for bolting to the gate leaf while attached to the gate leaf. Guide shoes shall be accurately located 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. Shims shall be provided as required.

2.3.15.5 Seal Assemblies

Seal assemblies shall be attached to the gate leaf during shop assembly and removed for shipment. The rubber seals of the assemblies shall be accurately fitted, drilled to match the seal retainers, match marked, and removed for shipment.

2.3.15.6 Lifting Beam Assembly

The lifting beam assembly shall be completely shop assembled in the sequence and manner shown. The balance of the completed assembly shall be checked 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, counterweighting or some other method approved shall be used to balance the assembly at the Contractor's expense.

2.3.15.7 Dogging Devices

Dogging devices shall be completely shop assembled. Pin holes shall be drilled in base plates and dogs with these components in assembly.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit certified material test reports with all material delivered to the site. Tests, inspections, and verifications for materials and fabricated items shall conform to the requirements specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.1 Testing of Rubber Seals

The fluorocarbon film of rubber seals shall be tested for adhesion bond in accordance with ASTM D413 using either the machine method or the deadweight method. A 25 mm 1 inch long piece of seal shall be cut from the end of the seal which has been masked and subjected to tension at an angle approximately 90 degrees to the rubber surface. There shall be no separation between the 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
0.726 mm0.030 in.	13.6 kg per 25 mm30 lbs per inch width	13.6 kg per 25 mm30 lbs per inch width
1.524 mm0.060 in.	13.6 kg per 25 mm30 lbs per inch width	13.6 kg per 25 mm30 lbs per inch width

2.4.2 Inspection

Shop assembled components shall be inspected for accurate fit and compliance with dimensional tolerances. Sealing, guiding, and connecting surfaces shall be inspected to determine if their planes are true, parallel, and in uniform contact with opposing surfaces. With the gate leaf closed and uniformly blocked in the sealing position, gate leaf [wheels,] [rollers,] [bar seals,] [and] [rubber seals] shall be inspected to determine if they are in continuous contact with [track] [and] [seal plates]. [Compression of rubber seals shall not vary by more than 1 mm 1/32 inch.] [It shall not be possible to insert a feeler gauge of greater than [0.076] [0.127] mm [0.003] [0.005] inch thickness at any point between bar seals and seal plates.]

2.4.3 Operation Tests

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NOTE: This paragraph must be edited to fit the project.
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The operation of the shop-assembled gate assembly shall be tested by opening and closing the gate several times by use of the operating machinery. The force used to operate the gate shall be the minimum required to open and close the gate. Since the sill of the unembedded gate frame is not fully supported during the operation tests, special precaution shall be taken to prevent the application of excessive force on the gate leaf and frame when the gate is closed. The operation of the lifting beam shall be tested by engaging and disengaging the lifting beam several times. Adjustments shall be made as required until operations are satisfactory. The gate assembly shall be tested hydrostatically by applying a hydrostatic pressure of [_____] kPa psi, measured at the sill of the gate frame, to the upstream side of the gate leaf in the closed position. For conducting the hydrostatic testing, the gate frame shall be bulkheaded or restrained by some other method as approved. Under hydrostatic testing, the gate seals shall be sufficiently tight to prevent water leakage.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform with the requirements specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Gate and appurtenant items shall be assembled for installation in strict accordance with the contract drawings, approved installation drawings, and shop match-markings. Bearing surfaces requiring lubrication shall be thoroughly cleaned and lubricated with an approved lubricant before assembly and installation. Components to be field welded shall be in correct alignment before welding is commenced.

3.1.1 Embedded Metals

Frames, bases, and other embedded metal items shall be accurately installed to the alignment and grade required to ensure accurate fitting and matching of components. Shims, jackbolts, or other supports required to align and hold components rigidly in place until embedment concrete has attained the specified strength shall be provided. Anchors shall be installed as shown. Embedded metals shall be given a primer coat of the required paint on all surfaces prior to installation in concrete forms. Items requiring two concrete pours for installation shall be attached to the embedded anchors after the initial pour, adjusted to the proper alignment, and concreted in place with the second pour.

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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Gate frame and guides shall be connected to embedded anchors, aligned, and rigidly blocked in place prior to the placement of second-pour concrete. The sealing surfaces of the slide gate frame seal bars shall serve as the reference plane for the installation alignment. Alignment shall be to 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. The gate frame shall be aligned to within 0.381 mm 0.015 inch of control planes "A" and "B". A taut piano wire and an electric micrometer or some other approved method shall be used to measure the vertical alignment tolerances. The alignment of [wheel gate] [and] [roller gate] frame and guides shall be such that planes through the bearing surfaces of track plates and the sealing surfaces of seal plates shall be within 2 mm 1/16 inch of the alignment shown. Gate frame and guides shall be tested 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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Gate leaf shall be completely assembled, including the attachment of all components and accessories, prior to being placed in the gate frame. All necessary precautions shall be taken to avoid distortion of the gate leaf and attached components during installation. Rubber seals shall be fastened securely to metal retainers. Before operating the gate, a suitable lubricant shall be applied 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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Operating machinery for the gate assembly and supporting components, including [bonnet,] [bonnet cover,] [pedestal,] [and] [base plate], shall be positioned and aligned to the installed location of the gate frame and guides and anchored in place. The location of the slide gate stem shall be projected to and scribed on the sill of the installed gate frame to serve as a reference point for the alignment of operating machinery and supporting components. Operating machinery and components shall be aligned to within 0.762 mm 0.030 inch of the reference point. Prior to being embedded in concrete, an alignment template shall be bolted 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

The embedment of the gate frame and other components in concrete shall be performed 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, any voids around embedded components shall be filled by pumping concrete grout around the components. After the pumped grout has cured for at least 7 days, hammer blows to the components shall be used to detect any remaining voids. Where remaining voids are located, 25 mm 1 inch diameter grout holes shall be drilled in the components and the voids shall be filled by pressure grouting through the grout holes. Grout holes in the components shall be plugged by welding and shall be ground flush.

3.1.6 Painting

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

3.2 OPERATING MACHINERY

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NOTE: Specify appropriate section for vertical lift gate operating machinery.
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Operating machinery shall conform to Section [_____].

3.3 ACCEPTANCE TRIAL OPERATION AND TEST

After the gate assembly has been installed, including operating machinery, the Contracting Officer will examine the complete system for final acceptance. Operation and test results shall be furnished 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. [The gate shall be operated 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.] The initial operation of the gate assembly shall be conducted 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, the rubber seals shall be checked to ensure that they are uniformly compressed against the seal plates.] [The gate lock assembly shall be tested by destructing one set of lock pins. This shall be accomplished 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. The pressure shall be adjusted at the pressure reducing valve to its lowest setting and gradually increased until the pins fail. The pressure reading at failure of the lock pins shall be recorded in the operation and test report. After completion of the test, broken pins shall be replaced by new ones.] The second trial operation and testing of the gate assembly shall be conducted with the reservoir normal operating pool hydrostatic pressure. The workmanship in the fabrication and installation of the gate assembly shall be such that the gate leaf shall form a watertight barrier when lowered to the seated position. Adjustments shall be made to the operation and control apparatus until all components function as required. The [lifting beam assembly,] [lifting sling,] [dogging devices,] and other appurtenances will be inspected to assure proper operation. Required repairs or replacements to correct defects, as determined by the Contracting Officer, shall be made at no additional cost to the Government. The trial operation and testing shall be repeated after defects are corrected.

3.4 PROTECTION OF FINISHED WORK

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

-- End of Section --