UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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USACE / NAVFAC / AFCEC / NASA **UFGS-35 20 16.54 (May 2021)**

Preparing Activity: USACE **New**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

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SECTION 35 20 16.54

SLIDE GATES AND ACTUATORS
05/21

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NOTE: This guide specification covers the requirements for the fabrication, assembly, delivery, and installation of slide gates and actuators . This section was originally developed for USACE Civil Works projects.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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).

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PART 1 GENERAL

1.1 SCOPE

The work provided for herein consists of furnishing all plant, labor, materials and equipment and designing, manufacturing, factory testing, delivering, storing, installing and field testing [__#___] slide gates and actuators complete with all necessary accessories and appurtenances, all as shown on the contract drawings and specified herein. Cast-Iron slide gates must be constructed and assembled in accordance with AWWA C560. Fabricated Stainless-Steel slide gates must be constructed and assembled

in accordance with AWWA C561. Electric actuators must meet the requirements of AWWA C542. Electrical work is specified in the applicable sections of Division 26 - ELECTRICAL.

1.2 GENERAL REQUIREMENTS

>The contract drawings indicate the requirements and general arrangement of the slide gates and actuators. The slide gates and assembly must fit into the allotted space and allow adequate acceptable clearances for installation, replacement, servicing, and maintenance. The following paragraphs may at times describe or refer to only one item, assembly or arrangement, but these requirements apply to all such items, assemblies or arrangements furnished and installed under these specifications.

1.3 MEASUREMENT AND PAYMENT

The slide gates will not be measured for payment. Payment will be made at the contract job price for "Slide Gates." Price and payment constitute full compensation for furnishing all plant, labor, material and equipment and designing, manufacturing, assembling, factory testing, preserving, delivering, storing, installing and field testing the gates, [including painting] and all appurtenant work, services and parts required.

1.4 REFERENCES

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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.

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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 GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 6010	(1997F) Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C542	(2016) Electric Motor Actuators for Valves and Slide Gates
AWWA C560	(2014) Cast-Iron Slide Gates
AWWA C561	(2012) Fabricated Stainless-Steel Slide Gates

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A126	(2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A240/A240M	(2023) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A351/A351M	(2018) Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM B21/B21M	(2020) Standard Specification for Naval Brass Rod, Bar, and Shapes
ASTM B98/B98M	(2013) Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B150/B150M	(2012; R 2017) Standard Specification for Aluminum Bronze Rod, Bar, and Shapes
ASTM B584	(2022) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D4020	(2011) Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
ASTM F593	(2022) Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2021) Motors and Generators

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual

1.5 DESIGN

The slide gates must be products of a manufacturer who has been regularly engaged during the past five years in the production of similar-sized gates for the design heads specified herein. Based on the heads specified, working stresses must not exceed the lower value of either one-half of the yield strength or one-fifth of the ultimate strength of the material. Design the gates accessories and appurtenances for installation as shown on the contract drawings.

1.6 ERECTING ENGINEER

Furnish the services of a competent erecting engineer to supervise and direct the installation and testing of the gates furnished under this section. Provide erecting engineer that is a full-time employee of, and designated as such by, the gate manufacturer, has at least five years of experience with the type of gate furnished under these specifications and will be subject to the approval of the Contracting Officer. The services of the engineer will be furnished at no extra cost to the Government. The installation and testing of the gates under the direction and supervision of the erecting engineer in no way relieves the Contractor of sole responsibility for the gates meeting all requirements of the specifications and fulfilling all the Contractor's guarantees.

1.7 WORKMANSHIP

All workmanship, whether in the factory or the field, must be performed in a skillful and workmanlike manner by qualified mechanics under competent supervision and direction and in accordance with the best modern practice for the various trades involved and for the manufacture of high-grade machinery. All parts must have accurately machined mounting and bearing surfaces so that they can be assembled without fitting, chipping or remachining. All parts must conform to the design dimensions and be free of defects in either workmanship or material that will impair their service. All attaching bolt holes must be accurately drilled to the layout indicated on the shop drawings and dimensional outline drawings.

1.8 SUBMITTALS

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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

Shop Drawings; G[, [_____]]

Dimensional Outline Drawings; G[, [_____]]

Furnish the Contracting Officer for his review and approval dimensional outline drawings, catalog data and other information and calculations for each size unit which will include at least the following:

(1) Name of actuator manufacturer.

(2) Model number and weight.

(3) Dimensional drawing.

(4) Descriptive bulletin, including a breakaway drawing illustrating all operating components, a parts list and materials of construction.

(5) Strength and durability HP ratings per AGMA 6010.

(6) The electric motor's HP rating, the starting, running, and locked rotor torques, full load and locked rotor amps.

(7) The maximum and operating stem opening and closing load.

(8) Equipment sizing calculations, including all related factors and supporting literature.

(9) The maximum output of the motor operated actuator with the torque limiting switch inoperative.

(10) Calculations showing the required stem size and bracing required under condition (9) above for L/R < 200.

(11) Control wiring diagram.

SD-06 Test Reports

Quality Control Field Test Report; G[, [_____]]

Within three (3) days of a successful Quality Control Field Test, the Contractor must submit the Quality Control Field Test Report.

SD-10 Operation and Maintenance Data

Provide both electronic (PDF) and hard copies of Operation and Maintenance Manuals. All manuals and parts lists must be bound separately, be approximately 8-1/2 inches by 11 inches, printed on good quality paper and bound between flexible, durable covers. Drawings incorporated in the manual and/or parts lists may be reduced to page size provided they are clear and easily legible, or may be folded into the manual to page size. Photographs and/or catalog cuts of components may be included for identification. Submit the operation and maintenance manual and parts lists at the time of shipment of the gate actuators. Provide manuals for each type of slide gate and gate actuator.

Installation Manual; G[, [_____]]

Operation And Maintenance Manuals; G[, [_____]]

1.9 SUBMITTAL DESCRIPTIONS

The following subparagraphs describe in detail the submittals pertaining to the work specified in this section.

1.9.1 Shop Drawings

Submit complete shop drawings of the gate to the Contracting Officer for approval. Drawings of any items made specially or specifically for this project must be true shop drawings, but catalog cuts are sufficient for standard manufactured articles, and outline drawings of such equipment may be used in the assembly drawings. However, for those items for which true shop drawings are not required, sufficient descriptive data and/or other information, in addition to the catalog cuts, must be submitted to demonstrate compliance with the specifications. The embedded items and structural openings and clearances, which are dependent upon the gate design, must be included with the shop drawings.

1.9.2 Installation Manual

A minimum of 30 days prior to shipment of the slide gate and gate

actuator, submit three (3) copies of the gate manufacturer's standard manual describing procedures to be followed by the field service representative in installing and adjusting the slide gates, gate actuators and appurtenances not furnished by the Government. The installation manual must be of such a nature that it may be comprehended by an engineer or mechanic without extensive experience in erecting slide gates of this type. The description must be a step by step explanation of operations required, and include, where applicable, such things as gate component alignment procedures, bolt torque values, limit switch setting adjustment, wedge block adjustment and similar details.

1.9.3 Operation and Maintenance Manuals

Submit five (5) hard copies of all operation and maintenance, lubrication, and repair manuals for all equipment not furnished by the Government. Submit also in electronic format (PDF). Furnish operation and maintenance manuals containing complete information in connection with the operation, lubrication, adjustment, routine and/or special maintenance, disassembly, repair and reassembly of the manual and electric motor driven gate actuators and appurtenances furnished under this section. Furnish copies of the manufacturer's spare parts lists and/or bulletins for the gate actuators and appurtenances. Clearly show all details and parts, and adequately describe all parts or have proper identification marks. Submit the operation and maintenance manual and parts lists at the time of shipment of the gate actuators.

1.10 QUALITY CONTROL

1.10.1 General

Establish and maintain quality control for slide gate operations to assure compliance with contract requirements and maintain records of quality control for all construction operations, including but not limited to the following:

(1) Machine work and electrical work.

(2) Shop painting.

(3) Galvanizing.

(4) Use of specified materials and equipment.

(5) Shop assembly and tests.

(6) Preparation for shipment and storage.

(7) Inspection at the worksite for damage to and defects in all material and equipment.

(8) Storage at the worksite.

(9) Field painting.

(10) Installation and tests.

(11) Operation and maintenance after installation.

1.10.2 Reporting

The original and four copies of these records of inspection and tests, as well as the corrective action taken, must be furnished to the Government daily. Format report as prescribed in Section [01 45 00][01 45 00.00 40] QUALITY CONTROL.

1.11 PREPARATION FOR SHIPMENT

Prior to shipment from the manufacturer's plant, prepare the gate for shipment as described herein. All large, bulky and/or heavy, greater than [50][_____] kilograms[100][_____] pounds, elements must be mounted on skids or pallets of ample size and strength to facilitate loading and unloading. Pack all small parts in sturdy wood or heavy corrugated paperboard boxes. Provide a packing list, indicating the contents of each such box and enclose in a moisture-proof envelope securely fastened to the outside of the box. The skid and/or pallet mounting and the boxing must be done in a manner which will prevent damage to the gate during loading, shipment, unloading, storage and any associated and/or subsequent handling. Provide Weatherproof covers during shipment to protect all items which the Contracting officer designates as requiring such protection. Any special slings, strong backs, skidding attachments or other devices used in loading the equipment at the manufacturers' and/or fabricators' plants must be furnished for unloading and handling at the destination and become the property of the Government.

1.12 PREPARATION FOR STORAGE

At the conclusion of all shop tests, the gate must be protectively processed for not less than 24-month storage either outdoors or indoors as the case may be, at the destination. Furnish for approval, a complete description of the processing method or methods intended to use, including complete instructions for maintaining the protection during the storage period. Surfaces of items or portions of items which are to be embedded in or rest on concrete, must be cleaned of all dirt, rust, and other foreign coatings, not including closely-adhering mill scale, and then coated with a rust preventative.

1.13 STORAGE

Upon delivery at the worksite, bulky parts of the gates, such as the frames, slides and wall thimbles, which have been coated with a complete paint system in the manufacturer's plant, may be stored outdoors provided these parts are stored on wood blocking not less than 8 inches above a base of washed gravel or crushed stone not less than 2 inches thick. All other parts of the gates such as the gate stem, fasteners, and actuators store in a weathertight building. A framework covered with a plastic film, or any other such expedient or makeshift arrangement, will not be acceptable. Inspect the storage site at least once per day. Submit a detailed description of the proposed storage facilities, and a plan for storage maintenance and inspection, before any storage actually begins.

1.14 SAFETY

The Contractor is responsible for selection of plant operating equipment to ensure safe installation of the equipment specified herein, at the worksite, based upon the local working conditions, including site-specific restrictions for utilities, access or environmental conditions. Provide all equipment, labor and power, required for ventilation at the worksite

in order to ensure a safe working environment in accordance with EM 385-1-1, Safety and Health Requirements Manual, as well as any local, State, or National codes which apply to the work or work environment. The Contractor must test the air quality for toxicity, flammable gas and percentage of oxygen content prior to entering, and continuously during any work in an enclosed area. Use an air quality monitor from a recognized manufacturer to test the air quality.

1.15 WARRANTY

The Contractor must furnish to the Government, under separate cover, the manufacturer's standard commercial warranty for each size sluice gate and gate actuator, but not less than a minimum of 1 year warranty must be provided.

1.16 MAINTENANCE

After completion of the installation, continue to maintain and protect the gate and keep it ready for operation at any time until acceptance thereof. Provide electrical power in accordance with applicable Sections in Division 26 - ELECTRICAL for all operation and testing of the gates until final acceptance by the Government.

PART 2 PRODUCTS

2.1 MATERIALS

All materials must be free from defects and imperfections, of recent manufacture and unused, and of the classifications and grades specified herein unless otherwise approved by the Contracting Officer. Material not specifically described, as far as practicable, conform to the latest specifications of the American Society for Testing and Materials. All materials, supplies and articles not manufactured by the Contractor must be the products of recognized reputable manufacturers. Submit samples of materials for approval when so directed. Equipment, materials and articles installed or used without such approval are at risk of subsequent rejection.

2.1.1 Iron Castings

Material for iron castings must meet the applicable requirements of either ASTM A48/A48M for Class Nos. 30A, 30B or 30C or ASTM A126 for Class B.

2.1.2 Structural Steel

Structural steel used for shop fabricated items such as the gate actuator pedestals must meet the applicable requirements of ASTM A36/A36M. The contrctor may submit other gate material for approval.

2.1.3 Bronze

Bronze castings for such items as wedges, thrust nuts, lift nuts and couplings must meet the applicable requirements of ASTM B584 for Copper Alloy No. 865. Bronze extrusions for seat facings in the frame and slide must meet the applicable requirements of ASTM B21/B21M for Copper Alloy No. 464 or No. 482. Bronze for adjusting screws and lock nuts must meet the applicable requirements of ASTM B98/B98M for Copper Alloy No. 651 or No. 655. or ASTM B150/B150M for Copper Alloy No. 614, No. 623, or No. 630.

2.1.4 Stainless Steel

Stainless steel rods for stems must meet the applicable requirements of ASTM A276/A276M for Type 304 or 316. Stainless steel for fasteners must meet either the above-mentioned specification or the applicable requirements of ASTM F593 alloy group 1 Type 304. Stainless steel for slides and frames must meet the applicable requirements of ASTM A276/A276M for Type 304 or 316 or ASTM A240/A240M for Type 304L or 316L.

2.2 EQUIPMENT

The following equipment, together with all necessary accessories and appurtenances, must be installed. The following paragraphs may at times describe or refer to only one item, assembly, or arrangement, but these requirements apply to all such items, assemblies, or arrangements furnished under these specifications.

2.2.1 Gate

The [_____] gates for control structure [_____] must fit an opening [xx inches] wide X [xx inches] high, be designed for a maximum head of [xx feet] and an operating head of [x feet], and withstand an unseating head of [x feet]. Each gate must be cast-iron, fully bronze mounted, have side wedging devices for seating heads, and be the rising stem type. Each gate must be stainless steel, non self-contained, rising stem, standard bottom closure type. Cast-iron gates must meet the requirements of AWWA C560. Fabricated stainless steel gates must meet the requirements of AWWA C561.

[

No. Required	Opening Size	Location	Seating Head FT	Unseating Head FT	Type of Actuator	Type of Invert
1	in x in					

]

2.2.2 Frame

The frame must be the flat back type and of one piece, cast-iron construction. All contact surfaces of the frame must be machine-finished. The frame must have machined dovetail type grooves on its front face to accommodate the seat facings. The back face of the frame must be drilled and machined to bolt directly to the machined face of the thimble. Drill all bolt holes using templates to match the thimble. The frame must have integrally cast pads with machined surfaces and keyways to receive the side, wedging devices.

Construct the frame assembly of formed stainless steel plate with a minimum thickness of 1/4 inch. The frame must be of the flange back type design for mounting on a concrete wall with the use of embedded adhesive anchor bolts and grout pad. Size and spacing of anchor bolt holes must be suitable for the operating conditions of the gate. Anchor bolt hole spacing must not exceed [12 inches]. The frame must be of the [non self-contained] [self-contained] design. Design the frame sufficiently rigid to transfer hydrostatic loads to the gate anchorage. The frame must positively retain the polymer guide/seal strip and the neoprene loading pad on studs welded to it. Use non-loosening fasteners on the gate guide

assembly.

2.2.3 Guides Guides and Seals

The guides must be of one-piece, cast-iron construction, conservatively designed to withstand the total thrust due to the water pressure and the wedging action. The guides must be machine-finished on all contact surfaces, and machine a groove the full length of the guide to provide sufficient clearance between the slide tongue and the guide groove to permit free movement and ensure proper engagement of the wedging devices. The guides must have machined areas on their front faces for at least one-half the vertical gate opening and be sufficiently long to retain and support at least one-half of the slide when the gate is in the full-open position. Attach the guides to the frame with steel and bronze fasteners and dowel to prevent relative motion between the guides and frame. Provide integrally cast pads with machined surfaces for attachment of the wedging devices.

The length of the guide must retain at least 2/3 of the slide height in the full open position. The guides must be conservatively designed to withstand the total thrust due to the water pressure. The guide seals must be specially milled or molded ASTM D4020 to positively retain the slide, form a tight seal, and restrict leakage. Seals must prevent metal to metal contact between the frame and slide. Sealing must be accomplished by pinching action of the polymer guide seal. Provide gate with a self-adjusting seal system to restrict leakage in accordance with the requirements of this specification. The guide seal assembly must be field adjustable and replaceable. The UHMW sealing system must maintain efficient sealing in any gate position.

2.2.4 Slide

The slide must be either square or rectangular and of one-piece, cast-iron construction with integrally-cast vertical and horizontal ribs and a reinforced section around the perimeter to provide for the seat facings. The slide must have machined areas on its seating face to accommodate the seat facings. Provide a tongue on each side of the slide, which extends its full length and machined on all sides to provide sufficient clearance between the tongue and the guide groove to permit free movement. Integrally cast pads must be provided and machine-finished to receive the wedges. A stem nut pocket must be cast integrally on the vertical centerline and above the horizontal center and be shaped to receive the stem nut.

The slide must be either square or rectangular and formed of welded stainless steel plate with integrally formed reinforcements at the top and bottom with welded interior reinforcements. The slide must have at least one vertical reinforcement on or adjacent to the vertical center line. All edges and corners must be rounded and polished for smooth operation within the guide seal assembly. Incorporate measures for attaching the stem to the gate with a clevis-type connection welded to the slide.

2.2.5 Wedging Devices

The gate must be provided with sufficient side wedging devices to limit leakage to 0.1 gallon per minute per foot of perimeter at the specified maximum seating heads. The wedging devices must be of solid cast bronze, machine-finished on all contact surfaces and keyed to the cast-iron pads to maintain adjustment. The wedging devices must be attached with either

bronze or steel studs and bronze nuts, and the adjustable element be provided with a bronze adjusting screw with either a bronze lock nut or another approved locking device.

The gate must be provided with top wedging devices if recommended by the manufacturer to provide a practical degree of water-tightness. The wedging devices must be stainless steel castings and held onto the slide reinforcing member with two inline welded studs with backing plate. The wedging devices must be adjustable and provided with a positive means of locking. Wedging devices must be one piece and removable and replaceable without disassembly of other gate parts. Material for stainless steel castings must meet the requirements of ASTM A351/A351M-CF8M.

2.2.6 Seat Facings

Seat facings must be of extruded bronze. The facings must be of a special shape which, when impacted into place, will fill and be locked permanently into the dovetail-type grooves in the frame, and gate slide. Other methods of attachment will not be permitted. The width of the facing must be not less than 3/4-inch. After attachment, machine the facing to a plane surface and to at least a 63 micro-inch finish. The seal must be a specially molded shape designed to produce a wide sealing area on the machined stop bar bolted to the frame. The differential sealing pressure of the seal on the stop bar must be capable of being varied by adjustment of the side wedging devices. When the gate slide is in the fully closed position and wedged into position against the frame, the maximum clearance between the seating faces must not exceed 0.004 inch.

2.2.7 Wall Thimble

The wall thimble must be of one-piece, square front flange with a square opening made of cast-iron construction ASTM A126 or approved equal. The wall thimble must be of the "F" Type design unless the gate manufacturer requires an "E" type design based on the unseating heads present. Provide the thimbles with an integrally cast ring or water stop. The front flange face must be machine finished to a plane surface and provided with tapped holes, using a template to match the drilling of the frame. The vertical centerline must be clearly shown by permanent marks at the top and bottom of the machined surface and permanently mark the word "TOP" thereon. Provide the thimble with holes in the invert to permit satisfactory concrete placement. Provide a permanent gasket of uniform thickness between the front face of the thimble and the back face of the frame.

2.2.8 Stem, Couplings and Stem Guides

The stem must be of sufficient diameter to withstand, without buckling or permanent distortion, the stresses induced by closing the gate under locked torque conditions. Stem threads must be either machine-cut or cold rolled and of the double-lead ACME type. The stem and nut threads must have sufficient contact area so that the contact pressure will not exceed 5,000 psi when the maximum stem thrust is exerted. The stem thread surfaces in contact with the lift nut must have not rougher than a 63 micro-inch finish if machine cut and not rougher than a 32 micro-inch finish if roll-formed. The exterior corners of the threads, either during or after machining, must be given a slight radius of approximately 0.015-inch in order to prevent them from acting as cutting edges as the stem passes through the lift nut. The stem must be of corrosion-resisting steel. Fit the stem with a tapped hole in the top end for handling. Make the tapped hole of sufficient diameter and depth for the insertion of an

eyebolt of sufficient strength to pick up the entire stem from a horizontal position. Provide the stem at its lower end with a bronze thrust nut which will fit into the pocket provided on the gate slide and which will positively prevent rotation of the stem. Stem guides must be of cast-iron, bronze bushed and mounted on cast iron brackets. Drill and slot stem guides to be adjustable in two directions and space at close enough intervals to support the stem adequately with an L/R ratio of not more than 200. The bronze bushing must be machine-bored 1/16-inch to 1/8-inch larger than the stem diameter. The stem guide, including the bronze bushing, must be the two-piece collar type which can be installed and removed with the stem in place. Attach stem guides with corrosion resistant steel anchor bolts.

2.2.9 Top and Bottom Seal

The top seal must be made of UHMW polyethylene attached to the top horizontal frame member. Provide seals with elastomer loading pads or continuous compression cords in order to ensure contact between the UHMW polyethylene and gate. Corners or intersections of seals and loading pads or compression cords be interlocked and sealed for a leak-proof joint. The bottom seal must be made of resilient neoprene attached to the bottom horizontal frame member and form a tight seal.

2.2.10 Anchor Bolts

New anchor bolts must be installed for the stem guides and actuator pedestal and fabricated slide gate frame if required. The anchor bolts must be adhesive anchors with stainless steel threaded rods provided with bronze nuts. The quantity, size, spacing, minimum pullout strength and required effective embedment depth of the anchors must be determined and provided by the manufacturer.

2.2.11 Fasteners

All fasteners must be of either silicon bronze or stainless steel. The quantity and size of fasteners per recommended by the gate manufacturer. Thread standards must meet the requirements of ASME B1.1

2.2.12 Stem Cover

Provide a stem cover for each slide gate actuator. The stem cover must be of galvanized steel pipe of sufficient diameter and length to permit full travel of the stem without obstruction or binding. The top of the cover is to be closed with a galvanized steel pipe cap. The pipe cap must have a drilled and tapped hole fitted with an eyebolt of sufficient strength for lifting the assembly from a horizontal position. The stem cover must have a grease fitting, which can be used for lubricating the stem, installed above the threads used for mounting the cover to the actuator. The cover is to be threaded into the top of the actuator to prevent rainwater entry. Prior to assembly, threaded portions of the stem cover, cap, and eyebolt are to be coated with pipe compound. After installation of the cover, clean exposed threads and degrease, then apply a heavy coat of an approved zinc-rich protective coating.

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NOTE: Designer select either paragraph MANUALLY OPERATED GATE ACTUATOR or paragraph ELECTRIC MOTOR DRIVEN GATE ACTUATOR based on project requirements.

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[2.3 MANUALLY OPERATED GATE ACTUATOR

Open and close each slide gate by means of a manual crank-operated actuator having either a single or double gear reduction depending upon the load and mounted as shown on the drawings. The actuator must have cast bronze lift nuts threaded to match and engage with the stem threads. Provide the lift nuts with ball thrust or tapered roller bearings both above and below the flanges on the lift nut to accommodate the opening and closing thrusts. The actuator housing must be cast iron. Provide adjustable stop collars for installation on the stem just above the lift nut and accessibly below the hoist. All gearing must be steel and have accurately machine-cut teeth. Positive mechanical seals to retain lubricant and exclude dirt and moisture are to be provided on the lift nut and pinion shafts where they extend through the housing. Provide lubrication fittings for lubrication of all gears and bearings. A removable cast-iron crank with a rotating brass grip and a maximum radius of 380 mm15 inches must be provided. Fit the actuator with a 2 inch square nut for operation with a portable electric drill. Design the actuator such that a maximum force of 178 N40 pounds at a 380 mm15 inch radius will unseat the slide from its wedging devices at maximum design head. After the slide is unseated from its wedges a maximum force of 111 N 25 pounds at a 380 mm15 inch radius must operate the gate.

The actuator unit must include a cast-iron pedestal, drilled and machined to accommodate the gear and lift nut housing, arranged to be bolted to the operating platform, and designed to position the input shaft about 900 mm 36 inches above the platform. An arrow or arrows, with the word "OPEN" adjacent thereto, must be either permanently attached to or cast on the housing to indicate the direction of rotation to open the gate. Affix a brass instruction plate to the gate actuator stating manufacture, lubrication cycle and type of lubricant to be used.

][2.4 ELECTRIC MOTOR DRIVEN GATE ACTUATOR

2.4.1 General

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NOTE: Designer - The process for calculating gate actuation forces are described in AWWA C560 and AWWA C561 and Engineering Manual EM 1110-2-3105. EM 1110-2-3105 provides detailed sketches showing how these forces are applied.

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Each slide gate must be opened and closed by means of an individual electric motor actuator unit driven by an electric motor and mounted on the operating platforms as shown on the contract drawings. The unit must consist of complete, compact, rugged assemblies specially designed and manufactured for the required service by a manufacturer regularly engaged for at least 5 years in the production of this type of device, and be delivered completely wired, assembled and ready for installation. All parts of the lift mechanism must be designed to move the gate slide at a rate of approximately 1 foot per minute under the specified operating head condition. The actuator must be designed in conformance with the latest edition of standard practices of AGMA 6010. Gate actuation forces must follow the requirements as shown in Appendix A of AWWA C560 and AWWA C561.

The gate actuator requirements must be computed using the following

formula:

(a) $Fu = 62.4 \times H \times A \times fu + (Wg + Ws)$

(b) $Fn = 62.4 \times H \times A \times fn + (Wg + Ws)$

Fu = Minimum required unseating stem force, pounds

Fn = Minimum required stem force, pounds, after unseating

H = Operating head of water at gate disk centerline, feet

A = Area of gate opening, square feet

fu = 0.6 unseating friction factor

fn = 0.3 friction factor after unseating

Wg = Weight of gate disk, pounds

Ws = Weight of gate stem, pounds

2.4.2 Electric Gate Actuator Assembly

The electric motor for the gate actuator must have a continuous duty rating, be suitable for operation on a [240] [480] volt, 3 phase, 60 Hz circuit, have sufficient horsepower to operate the actuator unit through the full gate travel in both directions without exceeding the full load ampere rating, and conform to applicable requirements of NEMA MG 1. All bearings must be the anti friction type.

Actuator limit switches, torque switches and unit wiring must be provided in accordance with applicable section of Division 26 - ELECTRICAL. All components including the motor, reversing contactors and overload relays, pushbuttons, indicating lights, control transformer, reductions gearing, stem lift nuts, bearings and limit switches, must be enclosed in NEMA Type 4 enclosures and mounted on a cast iron pedestal with flanged base plate, complete with stainless steel anchor bolts and silicon bronze or stainless steel nuts. Design the pedestals to position the handwheel approximately 3 feet above the operating room floor on the standard slide gate installation.

a. Reduction gearing must consist of generated helical gears of heat-treated steel. Worms are to be of hardened alloy steel with threads ground and polished. The worm gear must be in one piece of high strength cast bronze. Run all reduction gearing in lubricant. All gears, the stem lift nuts and other working components must be carried on heavy duty ball or tapered roller bearings adequate for all torque and thrust loads imposed by operation of the gate at the specified maximum heads. Provide suitable seals at all points as required to retain the lubricant. Design the motor actuator to permit manual operation of the unit in event of power failure or as necessary during servicing.

b. Provide a handwheel, and an arrow with the word "OPEN" cast on the rim of the wheel, indicating the direction of opening. Effort required to operate the actuator manually with the gate in motion must not exceed 40 pounds at the wheel rim, and 80 pounds at the wheel rim to unseat the gate. The motor actuator must include a built in clutch

mechanism so that the handwheel will not rotate during motor operation nor turn during manual operation. Locate a dial type indicator at the top of the motor actuator to show gate position during both hand and motor operation. The indicator must be graduated to show "FULL OPEN" when the bottom of the gate is at the fully open position. House the indicator in a watertight enclosure. Indicators which are of the 3-position type showing fully open, fully shut or in an intermediate position are not acceptable. The actuator must be able to watch the indicator from the same position one stands in to operate the controls.

c. The operating unit must include a built in, lost motion device which will permit the motor to attain full speed after which a hammer blow must be imparted to the hoisting mechanism to initiate gate motion in either the opening or closing direction of travel. Supply bronze lift nuts, made in two pieces with accurately machined splines or keys and threads. The two piece nut consists of an outer member, having a flange or flanges on the exterior and splines on the interior, which mates with an inner member having splines on the exterior and threads on the interior. The outer member must be mounted in the unit housing. Secure the inner member to the outer member by either a threaded retainer ring or another suitable arrangement.

d. After the gate has been either completely closed or securely supported in the partially open position, this inner member must be capable of being easily removed by disassembling its retaining arrangement and turning the handwheel. Each stem nut must be adequately designed, factory tested and inspected with the stem with which it will operate. Run each nut by hand throughout the length of the stem with which it will operate. Suitable marks must be used to identify the matched sets once they have been established in the shop. The internal thread must have the lower or non working face relieved 1/64 inch to ensure that the threads will bottom out before wedging can occur. Drill the lift nut or otherwise provide with adequate oil recesses and passages to ensure passage of lubricant to all interior threaded surfaces of the nut. The internal arrangement of the motor actuator units must be such that all moving parts run in lubricant, with adequate fittings and seals provided to retain the lubricant. Use lubricant per recommendations by the gate actuator manufacturer.

2.4.3 Limit Switches

The closing and opening travel of each gate must be protected against overload by torque-responsive mechanical switches, one for each direction of travel. Provide geared limit switches for stopping the gate at both the fully closed and the normal fully open positions. The torque switches must be operative during the entire travel of the gate to protect the stem and gate against possible damage in the event an obstruction is met. The torque switches must function without auxiliary relays or other devices and be field-adjustable to ensure (1) stopping the lowering operation of the gate should the stem load for any reason become compressive to a degree greater than the normal seating requirements, and (2) stopping the raising operation should a 100 percent overload develop. Provide position limit switches thar are adjustable and of the intermediate gear type, governed by rotation of the motor driving mechanism. Internal motor control wiring for 120 volt operation and motor power wiring for [240] [480] volt, 3 phase, 60 Hz operation must be provided complete to a

suitable terminal block in the limit switch compartment, and clearly mark terminal blocks in a suitable manner to facilitate external control and power connections under another section of these specifications. All internal wiring must be not smaller than No. 12 stranded copper conductor with not less than 3/64-inch thick "NEOPRENE" or equal insulation and not less than a 1/64-inch thick "NEOPRENE" or equal jacket.

2.4.4 Gate Actuator Controls

2.4.4.1 Controls

Mount all controls on the side of limit switch compartment door with a hinged, padlockable, vandal resistant cover of at least 1/8 inch plate thickness and of NEMA Type 4 construction.

(a) Control Switch: One (1) selector switch with two positions, Open and Close.

(b) Selector Switch: One (1) heavy duty selector switch, five-position type with legend plate. Label the five positions LOCAL-STOP-OFF-STOP-REMOTE.

(c) Pilot Lights: Two (2) solid-state indicator LEDs for long life and ease of replacement with legend plates. Green for fully opened and red for the fully closed position.

(d) Legend Plates: Made of corrosion-resistant metal with permanent marking made by machine engraving or machine stamping; hand engraving, such as would be done with an engraving pencil, is not acceptable. Plates must be screwed or bolted in place.

2.4.4.2 Internal Control Features

In addition to the limit switches specified above, provide the following control features:

(a) A motor overload protective device in each phase.

(b) A terminal block with connectors for all external control signals. Route all leads from the actuator motor and limit switch assembly to terminal connections in the controller for external connections to other station control devices.

(c) A reversing controller which is both mechanically and electrically interlocked and provided with the necessary direct operated auxiliary contacts for required interlocking and control.

]PART 3 EXECUTION

3.1 PAINTING

Each cast-iron slide gate and actuator must be painted with a complete coating system in accordance with the manufacturer's standard practice, in which case it will be exempted entirely from the surface preparation and painting requirement specified in Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES, provided the coating system is approved by the Contracting Officer, is of acceptable color and is touched up as necessary prior to shipment. Requests for such exemption must be accompanied by a description of the manufacturer's standard coating system, including the

surface preparation, type of primer and finish coat or coats, dry film thickness and whether baked on or air dried. Fabricated stainless steel slide gates do not require painting.

3.2 LUBRICATION AND LUBRICANTS

Lubricate each actuator prior to any use or operation, either in the shop or in the field. Lubriacte each bearing through its associated lubrication fitting, and pack the gears with lubricant at assembly. After shop testing, and prior to shipment, relubricate the bearings. Prior to testing in the shop, and to initial operation in the field, the gate seat facings and wedging devices must be cleaned of all foreign material and lubricated thoroughly with a light grease. Just prior to field assembly, lubriacate the lift nut and stem threads. All lubricants must be as recommended by the gate and actuator manufacturer and be submitted by manufacturer's name and number as part of the shop drawings. Furnish an additional 20 poundsof each different actuator lubricant at no additional expense to the Government.

3.3 SHOP ASSEMBLY AND TESTS

After completion of initial machining, all gates must be completely assembled, in the vertical position, and the wedging devices adjusted to exclude a 0.004-inch thickness gage between the frame and slide seating surfaces. Perform any additional machining needed to achieve this condition, any discrepancies or deficiencies discovered as a result of this procedure must be corrected, and a retest conducted. Open and close the slide in the guides several times to ensure that it operates freely. Disassemble the gate to the extent necessary for shipment. The Contractor must notify the Contracting Officer sufficiently in advance (minimum 72 hours) so that a representative of the Contracting Officer may witness the assembly, testing and disassembly work, unless this requirement is waived in writing by the Contracting Officer. Any malfunctions or discrepancies disclosed as a result of these tests must be promptly remedied by the Contractor at no additional expense to the Government, and retests conducted.

3.4 FIELD INSTALLATION AND TESTS

3.4.1 Installation

Installation of the gates, actuators and appurtenances must be in accordance with the manufacturer's installation instructions and under the supervision and direction of the field service representative specified in paragraph "Erecting Engineer". Clean all elements of the gate of any protective coatings used thereon during shipment and storage, and remove all rust, dirt, grit and other foreign matter. The gate and actuator must then be "touch-up" painted. The actuator and each element of the gate must be carefully and accurately aligned so that after it is fastened in place there will be no binding or excessive pressure or wear in any moving part and no distortion of any member. Where the frame is attached to the structure by use of a wall thimble, apply mastic to the wall thimble contact surface per the manufacturers recommendation. Internally brace the wall thimble during concrete placement. Adjust each wedge assembly to ensure the specified minimum seal clearances without bending of wedge hooks or other damage to the wedges. Tighten fasteners uniformly and firmly, but take care to not overstress either the fastener or the member with which it is associated. Where specific torque values or ranges are cited in the installation instructions, an accurately calibrated

torque-wrench, having the proper capacity range, is required. Stilson wrenches, cold chisels, or other tools likely to cause injury to the surface of any part, are not permitted for use in the work of assembly or tightening. Install all fasteners with an anaerobic locking compound. Cleaning prior to application of the locking compound per the manufacturer's recommendations. All shims must be of either bronze or corrosion-resisting steel. Where grouting is required, either an epoxy grout or a ready-to-use, non-shrinking grouting material conforming to the applicable requirements of ASTM C1107/C1107M, requiring only mixing with water at the worksite, must be used, and use of any grouting as recommended by the manufacturer. All blocking and wedges used for support during initial grouting are to be removed prior to final grouting.

3.4.2 Field Tests

3.4.2.1 Quality Control Tests

The gates and actuators must be operated and tested by and at the expense of the Contractor and under the supervision and direction of the Erecting Engineer to determine if they have been properly manufactured, assembled, and installed and if they meet the requirements of the specifications. No Government representatives will be present during these tests. After all position and torque limit switches have been set, raise and lower the gate slide not less than three times using the electric motor operated gate actuator. Measure and record the operating current each time the gate is raised. Also raise and lower the gate slide approximately 6 inches using the manual handwheel. After completion of these tests the gates are to be fully closed and an inspection made of each of the seals to verify proper clearance between the seals at all points as specified or per the manufactuerer's recommendation. Adjust gate wedges and seals as required to acheive neccessary clearance for a proper seal. The Contractor must prepare a Quality Control Field Test Report indicating the test date, personnel present, number of times the gate was operated, operating current measured and written verification from the gate manufacturer's Erecting Engineer that all gates have been properly installed and adjusted and tested successfully.

3.4.2.2 Quality Assurance Tests

The gates and actuators must be operated and tested by and at the expense of the Contractor, under the supervision and direction of the Erecting Engineer and in the presence of representatives of the Contracting Officer to determine if they have been properly manufactured, assembled, and installed and if they meet the requirements of the specifications. These tests will be conducted a minimum of ten (10) days after receipt of the Quality Control Field Test Report. Raise and lower the gate a minimum of three times using the electric motor operated gate actuator. The Contractor must measure and record the operating current and motor amperage each time the gate is raised and lowered. Recorded operating current and motor amperage must be within manufacturer specified tolerance. The gate slide must also be raised and lowered approximately 6 inches using the manual handwheel. After the raising and lowering of the gates is completed the gates are to be fully closed and an inspection made of each of the seals to ensure that there is less than 0.004 inch clearance between the seals at all points or per recommeded by the gate manufacturer if otherwise approved. If any gate indicates a seal clearance in excess, that gate will be adjusted as required the rechecked. Any malfunctions or discrepancies disclosed as a result of these tests must be promptly remedied by the Contractor at no additional

expense to the Government, and retests conducted. [Contractor to develop a gate leakage test and submit for approval.]

3.5 MAINTENANCE

After completion of the installation, the Contractor must maintain and protect the gates and gate actuators and keep them ready for operation at any time until acceptance thereof.

-- End of Section --