SPECIFICATION: CAST IRON SLUICE GATES

PART 1  GENERAL

1.01  SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to install, ready for operation and field test cast iron, bronze mounted sluice gates and appurtenances as shown on the Contract Drawings and as specified herein.

B. The sluice gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C560 Standard for Cast Iron Slide Gates/Sluice Gate as modified herein.

1.02  SUBMITTALS

A. Provide the following information to confirm compliance with the specification in addition to the submittal requirements specified in Section ______.

1. Complete description of all materials.

2. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations.

3. Maximum bending stress and deflection of the slide under the maximum design head.

1.03  QUALITY ASSURANCE

A. Qualifications

1. The sluice gate manufacturer shall be ISO-9001:2008 certified.

2. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years’ experience producing cast iron sluice gates and shall have a minimum of 100 cast iron sluice gate installations. Gate frame and slide shall be cast in a foundry under the direct supervision of gate supplier’s personnel to ensure a high quality casting. If using a third party foundry, please submit list of foundry pre-qualifications and references for evaluation.

3. The manufacturer shall test each sluice gate specified on this specification section at its testing facility prior to shipment. Submit test reports per PART 2.03 Shop Testing.
PART 2  EQUIPMENT

2.01 GENERAL

A. Each Sluice gate will be manufactured as detailed here and shall be supplied duly tested as per requirements. The gate assembly comprising of frame, guides and shutter (Disc/Door) will be supplied as a factory assembled unit and shipped to site ready to install on the wall thimble or wall; wall thimble to be supplied earlier or together with the gate. This gate assembly will be uncrated at site and installed as a complete assembled unit without stripping down into components. This is to ensure that the performance integrity of the sluice gates remains as factory tested and supplied condition, thus minimizing the influence of the installation process to achieve optimum performance at site after installation.

B. The Sluice gates shall be manufactured from Cast Iron and shall be flat or flange back type suitable for wall thimble or wall mounting and generally manufactured in line with provisions of AWWA C-560 with improvements as described and specified below.

C. The gate manufacturer shall be:

   a) Rodney Hunt
   b) or approved equal.

D. The Sluice gates shall be designed for water tightness for both seating as well as off-seating differential pressure of 10 meter (33.8’) water column or as per the actual site requirement.

E. The Sluice gates shall have an on-seating / off-seating leakage rate of 50% less than the leakage rate allowed by AWWA-C560 standard or its latest revision.

F. All Sluice gates shall be shop tested to verify the leakage performance at operating head.
   
   • Hydrostatic tested at 1.5 times operating head, to verify soundness of casting.
   
   • Torque tested at operating head to verify the suitability of the actuating mechanism.
   
   • PMI (Positive Material Identification) tested to verify the compliance of raw material used.

Engineer reserves the right to witness testing or use an approved third party inspection agency.

G. The Sluice gates shall be of rising spindle (stem) type and operation shall be by means of a manual/electric operating mechanism.
H. The Sluice gate shall be supplied complete with all accessories such as: wall thimble, gate assembly, gasket between wall thimble and gate assembly, studs and nuts for mounting on the thimble, stem connecting block, spindle, spindle couplings, spindle guides, pedestal, operating mechanism as required, gate opening indicating arrangement and as required anchor bolts and fasteners for stem guides and pedestal.

I. The gate shall utilize adjustable wedges.

2.02 FRAME

A. The frame shall be cast iron, one-piece construction with rectangular opening. The frame shall be flat or flange back, conventional or self-contained as shown on the Contract Drawings.

B. The gate frame will be made from cast iron and shall be sufficiently rigid to withstand the designated water head. The gate frame shall either be flat back type or flange back type to suit the designed head and site condition.

C. Back flange of the gate aperture frame to be precisely machined flat and drilled to engage with the cast iron wall thimble mounted in the wall. A rubber gasket will be provided between the wall thimble and the gate for ease in dismounting of the gate for repairs / replacement and act as a seal to prevent any leakage between the flange of frame and wall thimble.

D. The gate frame of these sluice gates shall either be self contained type or non self contained type, depending upon site requirement. In case of non self contained gates the frames shall have short length extension guides and shall be without a yoke at their top. The length of extension guides in such cases shall be sufficient to engage at least half the overall vertical height of the door when the gate is fully open and shall be in accordance with the relevant provisions of AWWA C-560. In case of self contained gates the frames shall have full length extension guides and shall be provided with a yoke at their top. The length of extension guides in such cases shall be sufficient to engage the overall vertical height of door when the gate is full open position.

2.03 SLIDE

A. The gate slide door will be made from cast iron and shall be ribbed to withstand designated water head.

B. The gate slide will be provided with an integral pocket to house the thrust nut used to connect the stem with the slide.
2.04 SEATING/SEALING FACES

A. Seating/Sealing facing should be Bronze ASTM B-98 Alloy UNS C65500

B. Facing shall be attached into dovetailed or rectangular machined grooves in the gate frame and door, depending upon the applicable water head, and secured in place using taper screws which cannot be mechanically removed after fitting on facings. The taper screws adopted for facings shall be of same material as that of the seat facings.

C. To have a non-corroding, smooth sliding surfaces to the sealing faces of the shutter during its vertical travel and to enhance the service life of the gate, the front face of the integral extension guides in contact with the sealing faces on the door, shall also be fitted with sealing faces of the same material as that of the sealing faces on the door.

D. Finish: The mating seating/sealing faces on the gate frame and door shall be precisely finished for proper contact. They should be so finished that the clearance or gap, if any, between the mating sealing faces, in the gate closed position, does not exceed 0.1mm. After machining, the mating seating/sealing faces on the gate frame and door shall be hand scraped to achieve a closer tolerance fit and enhance superior gate sealing

2.05 WEDGING DEVICES

A. The Sluice gates shall be provided with individually adjustable wedging devices to ensure forced contact between frame and shutter seat facings, when the gate is in the closed position. Provision of individually adjustable wedges is necessary to enable adjustment of wedges on gates in installed condition in unseating water head condition.

B. Sluice gates used for seating head conditions only shall be provided with side wedging devices. Sluice gates used for unseating heads of sizes larger than 24”, shall be provided with side, top and bottom wedging devices or with side and top wedging devices and flush bottom closing arrangement as required.

C. The wedging devices comprise of: wedge brackets are fitted on the gate aperture frame and door. The wedge bracket on the frame shall remain in a fixed position and those on door shall be adjustable or vice versa. A (modified) slot and tenon arrangement shall be provided on the base of wedge brackets to prevent any tendency to shift. Provision shall be made to clamp the adjustable brackets firmly in adjusted position.

D. The wedging devices shall be made of cast bronze, machined on all contact surfaces keyed to the cast iron plate to maintain adjustment by preventing undesirable rotation or lateral motion.
2.06 CONVENTIONAL (CHASED INVERT) OR FLUSH BOTTOM CLOSING

A. The sluice gates shall be provided with conventional or flush bottom closure arrangement with corrosion resistant metallic contacting sealing faces at the bottom sill of gate. The invert of the gate is required to be kept above the floor of the channel/chamber by at least 6” to 10” depending upon the size and type of gate. The Engineer/Contractor should verify whether this clearance is available at the site of installation for fitting a conventional bottom closure gate. Debris must fall away and not impair the gates operation.

B. In case of conventional closing gate, if the invert of the gate is kept at the same level as that of the channel/chamber floor, there remains a slot or a groove at the invert of the gate. Debris, dirt, etc. may settle in this slot and may not allow the gate to close properly and this may impair the gate operation and lead to heavy leakage. To avoid this situation when the invert of the gate is to remain at the same level as that of the channel/floor, a Flush Bottom closing gate instead of Conventional Bottom Closing gate should be provided.

C. Flush Bottom Closing (Flush Invert) shall involve a flexible rubber seal at the bottom of the gate, mounted either on the shutter or on the frame, ensuring that the sealing face remains flush with the floor. The cast iron bar fitted at the bottom of the frame is required to be embedded in the channel/chamber floor and a recess of appropriate dimension shall be provided beneath the waterway opening along the gate invert, whilst constructing the floor. These dimensions shall be provided per actual site conditions and shown on arrangement drawings during the submittal process.

D. This cut out/recess is to be filled in during gate installation, using removable loose concrete mixed with sand dust or vermiculate, after putting the gate in position so that it is possible to break open this second stage grout for removal of the gate if needed.

2.07 STEM

A. The sluice gates shall be supplied with a rising type lifting spindles/stems. The stem shall be supplied with acme threading, length of threaded portion being about 8” more than the height of (waterway) opening. This extra length is supplied to allow for a minor variation of approximately 4” on either side of the specified height of the operating platform. Each operating stem shall be designed for a critical buckling compressive load caused by extreme output of the actuator with a safety factor of 2. The design of stem will be done as per the provision in AWWA C-560, as a minimum.

2.08 STEM GUIDES

A. Where needed stems shall be provided with a sufficient number of stem guides to prevent buckling of the stem. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.
B. The stem guide brackets shall be Adjustable Centre Type - wherein a separate stem guide is bolted on to the wall bracket. The stem guide shall be adjustable in the slots provided in the wall bracket, in a direction perpendicular to the face of the wall. Wall brackets should also offer minor adjustment in the direction parallel to the wall.

C. The stem guides shall have machine bored split journals to facilitate erection. The journal shall be lined with a brass/gunmetal bush.

2.09 STEM PROTECTION TUBES (PIPE HOOD)

A. A stem protection tube (Pipe hood) shall be supplied on the top of each headstock for rising spindle/stem gates to cover the spindle threads for protection against damage, dirt, dust, water etc. It shall be made of transparent fracture resistant polycarbonate material or galvanized steel. The pipe hood shall have vent holes to prevent condensation.

2.10 GATE OPENING INDICATING ARRANGEMENT

A. Gate opening indicating arrangement shall be provided to indicate the position of the door/disc shutter. This shall comprise of a full size scale, mounted on the side of each pipe hood and an indicator nut mounted on the rising spindle to show the extent of the opening and closing. The minimum scale graduation shall be 1”.

2.11 WALL THIMBLES

A. Cast iron wall thimbles shall be provided as shown on the Contract Drawings.

   a) The Wall thimble will be made from cast iron for placement in the concrete wall. Its front flange will be machined, drilled and tapped to match with the frame flange.

   b) The cross section of the thimble shall be F shaped and the depth of thimble shall be maximum 300 mm long or lesser in case wall thickness is less than 300mm. Gates subjected to high unseating heads shall have thimble cross section shaped E.

   c) To permit entrapped air to escape as the thimble is being encased in concrete, cast holes of 40mm diameter shall be provided at the bottom of the wall thimble in each entrapment zone.
2.12  MATERIAL OF CONSTRUCTION

Frame, Door, Thimble:  Cast Iron ASTM A126 Class B
Headstock, Stem Guides: Cast Iron ASTM A126 Class B or Stainless Steel ASTM A 240 type 304 / 316*
Stem Guide Bracket, Seating faces, Wedge Lining: Stainless Steel ASTM A 240 type 304/316 or Bronze ASTM B21 / ASTM B139
Rubber Seals (If applicable): EPDM or Neoprene ASTM D 2000
Rubber seal retainer bar: Stainless Steel ASTM A 240 type 304/316
Assembly bolts, nuts and fastener: Stainless Steel ASTM A 276 type 304/316
Stem & Coupling: Stainless Steel ASTM A 276 type 304/316
Yoke (If applicable): Carbon Steel or Stainless Steel ASTM A 276 type 304/316
Wedges, Thrust nut and Lift nut: Bronze ASTM B584

2.13  MANUAL GATE OPERATING HEADSTOCK/LIFT MECHANISM

A. Unless otherwise shown on the Drawings, gates shall be operated by a manual handwheel or a manual crank-operated gearbox.

  a) The operating gear headstock shall be designed for gate operation by a single person under the specified maximum operating head, with an effort of less than 40 ft-lbs on the crank /hand wheel.

  b) The operating gear headstock may be un-geared or a geared type and the geared head stock may be either of single speed or of double speed design, as necessary to make it convenient for one person to open or close the gate as fast as practicable. Two speed headstocks shall be supplied with gates requiring higher hoisting capacities. In this type of head stock, the low speed is meant for crack opening the gate when the effort required to open the gate is maximum, and the high speed is meant for further faster opening after the gate is crack opened.

  c) Geared headstocks shall be supplied with an easily removable crank handle or hand wheel with a radius not exceeding 15".
d) All the gears in a geared headstock shall be kept completely encased in a cast iron housing to protect them from damage, dirt, dust, water etc. and thus ensure their smooth operation. Grease nipples shall be provided at proper locations for lubricating with grease.

e) Headstock’s mounted on an operating platform, shall be supplied with a pedestal/floor stand to provide a convenient operating height of approximately 36” above the operating floor. The pedestal shall be provided with a covered window opening to enable cleaning and greasing of stem threads.

f) Pedestals shall be constructed of fabricated stainless steel or cast iron. Aluminum pedestals are not acceptable.

2.14 ELECTRIC MOTOR ACTUATORS

See Section ____.

2.15 ANCHOR BOLTS

A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates (if applicable) and the appurtenances.

   a) Quantity and location shall be determined by the gate manufacturer.

   b) If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.

   c) Anchor bolts shall have a minimum diameter of 1/2-inch.

2.16 PAINTING

A. These painting procedures shall be followed:

   d) Surface Preparation - Blast clean to near white metal finish.

   e) Priming - 1 coat of International Interseal 670 HS primer before & after shop testing.

   f) Finish Painting - International Interseal 670 HS, semi-gloss, 12-16 mils.

   g) Minimum DFT 9-18 mils inclusive of priming for gate assembly.

   h) Painting for yoke & Headstock - Epoxy International Interseal 670 HS primer.

   i) Minimum DFT 6-12 mils inclusive of priming for yoke and headstock.
2.17  SHOP TESTING

A. Following tests at manufacturers’ facility shall be conducted prior to shipment.

a) Shop Leakage Test
A leakage test by applying unseating hydraulic pressure will be conducted at manufacturer’s facility. Hydrostatic pressure equal to max seating/unseating head shall be applied to gate at center line of gate opening from the back, i.e. Unseating face of the gate in closed position, through positive displacement screw pump. A suitable scaled calibrated pressure gauge put on the unseating face of the gate shall indicate reading equal to unseating pressure head. Water leakage through the gate under above condition shall be collected in a collection pan and measured. The leakage measured should not exceed 50% of the limit as stated in AWWA C-560, or as specified. After the first leakage test, the gate will be fully opened and closed to un-wedge shutter/door and frame wedges. Leakage test will be once again conducted and leakage measured should not exceed 50% of the limit as stated in AWWA C-560 or as specified. In the interest of reliability, no alternate testing arrangement will be permitted in place of above.

b) Hydrostatic Body test
After the leakage test, a Hydrostatic body test will be conducted at manufacturer’s facility. A hydrostatic pressure equal to 1.5 times maximum operating head should be applied on the gate for 5 continuous minutes. No permanent deformation in casting should be observed.

c) Torque test at operating head for manual / electric operating arrangement
After conducting hydrostatic test, a torque test at operating head should be conducted at the manufacturer’s facility for gates up to 80" x 80". Torque required to open the gate with manual operating arrangement should not be in excess of 50 ft-lbs. In the case of an electrical operating mechanism, the torque and amperage measured should not exceed 80% of the rated torque and amperage of the actuator.

d) Seat clearance check
With the gate in a closed condition, a 0.1 mm thick feeler gauge should not pass through between seat facings.

e) Positive Material Identification Test
Positive Material Identification (PMI) test which gives the chemical composition of raw material used in gate manufacture is to be conducted during final inspection to document the raw material used.
PART 3 EXECUTION

3.01 INSTALLATION

A. Installation of the sluice gates and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer’s recommendations.

B. The CONTRACTOR shall review the installation drawings and installation instruction prior to installing the gates.

C. The sluice gate assemblies shall be installed in a true vertical plane, square and plumb.

D. The CONTRACTOR shall add a mastic gasket between the gate frame and wall thimble (when applicable) in accordance with the manufacturer’s recommendations.

E. The CONTRACTOR shall fill the void in between the gate frame and the wall with non-shrink grout (when applicable) as shown on the installation drawing and in accordance with the manufacturer’s recommendations.

3.02 FIELD TESTING

A. After installation, all gates shall be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured, and shall not exceed the maximum operating effort specified above. Electric motor actuators shall function smoothly and without interruption. Each gate shall be water tested by the CONTRACTOR, at the discretion of the ENGINEER and OWNER, to confirm that leakage does not exceed the specified allowable leakage.