

## 1 GENERAL

### 1.01 REFERENCE STANDARDS

- .1 ASTM International
  - .1 ASTM A1-00 (2018), Standard Specification for Carbon Steel Tee Rails.
  - .2 ASTM A53-12, Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .3 ASTM A108-13, Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
  - .4 ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .5 ASTM A148-15a, Standards Specification for Steel Castings, High Strength, for Structural Purposes.
  - .6 ASTM A276-17, Specification for Stainless Steel Bars and Shapes.
  - .7 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
  - .8 ASTM A320-14e1, Specification for Alloys, Steel Bolting Materials for Low-Temperature Service.
  - .9 ASTM A325M-14, Specification for High-Strength Bolts for Structural Steel Joints (Metric).
  - .10 ASTM A490-14a, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength (Withdrawn 2016).
  - .11 ASTM B22-17, Bronze Casting for Bridges and Turntables.
  - .12 ASTM B62-17, Standard for Composition Bronze or Ounce Metal Casting.
  - .13 ASTM F835-16, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
  - .14 ASTM F3111-16, Standard Specification for heavy Hex Structural Bolt/Nut/Washer Assemblies, Alloy Steel, heat Treated, 200 ksi Minimum Tensile Strength.
- .2 Canadian Standards Association (CSA)
  - .1 CSA-G40.20, General Requirements for Rolled or Welded Structural Quality Steel.
  - .2 CSA-G40.21, Structural Quality Steel.
  - .3 CAN/CSA-S16, Limit States Design of Steel Structures.
  - .4 CSA-W47.1, Certification of Companies for Fusion Welding of Steel Structures.
  - .5 CSA-W48, Filler Metals and Allied Materials for Metal Arc Welding.
  - .6 CSA-W59M, Welded Steel Construction (Metal Arc Welding) (Metric Version).
- .3 American Iron and Steel Association
  - .1 AISI 304, Steel, Stainless.
  - .2 AISI 1035, Carbon Steel.
  - .3 AISI 1045, Steel, Cold Drawn, High Temperature Stress Relieved.
- .4 Standards Council of Canada
  - .1 CAN G28-1968, Carbon-Steel Casting for General Applications.
- .5 U.S. Army Corps of Engineers
  - .1 EM 1110-2-2702 (2000), Design of Spillway Tainter Gates.

- .6 NACE International
  - .1 NACE RP0178-2007, Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
- .7 Natural Resources Canada (NRCan) National Non-Destructive Testing Certification Body (NDTCB)
  - .1 CAN/CGSB-48.9712-2014, Qualification and Certification of Non-Destructive Testing Personnel.

## 1.02 REFERENCE DOCUMENTS

- .1 "St. Andrews Rapids Lock Socket for Turning Lever" Drawing, Public Works, Canada, Unknown Year.

## 1.03 SUBMITTALS

- .1 Shop drawings at least 20 days prior to fabrication of all metalwork. Indicate material specifications, dimensions, weights, finishes, welds and other details.
- .2 Details of CSA welding certification of the fabricator at least 30 days prior to fabrication.
- .3 Submit details of surface preparation and coating application procedures and equipment at least 7 days before proceeding with such work.
- .4 Submit Contractor's Metal Fabrication - Quality Control Program and Inspection Plan.
- .5 Submit proof of certification of NDT inspectors as per CAN/CGSB-48.9712-2014, *Qualification and Certification of Non-Destructive Testing Personnel*.

## 1.04 QUALITY CONTROL

- .1 Test Structural and miscellaneous steel fabrication and erection during all phases of fabrication.
  - .1 Verify the type and quality of materials, and compliance of fabrication with design, size, and weight of members and assemblies.
  - .2 Inspect bolted connections and test in accordance with CSA S16, Section 23.
- .2 Contractor's Metal Fabrication - Quality Control Program and Inspection Plan to include:
  - .1 Sufficient detail to delineate items to be inspected and the manner of inspection.
  - .2 Include the control, storage and inspection of welding consumables and equipment.
  - .3 Adequately describe proposed fabrication quality control activities, including provision for adequate documentation of the Contractor's performance of such quality control and inspection.
  - .4 Records of inspection and certified reports of tests performed by the Contractor or third parties shall be submitted to the Departmental Representative upon request.
  - .5 Complete non-destructive testing (NDT) as specified:
    - .1 Visual Examination
      - .1 Visual examination procedures in accordance with CSA W59.

- .2 All welds are to be visually inspected.
- .2 Ultrasonic (UT) or Radiographic (RT) Examination
  - .1 UT and RT examination procedures in accordance with CSA W59.
  - .2 Complete penetration welds to be examined by UT or RT.
- .3 Magnetic Particle Inspection (MPI)
  - .1 Magnetic Particle Inspection procedures in accordance with CSA W59.
  - .2 All fillet welds by minimum 10% of total weld length.
- .4 The Departmental Representative reserves the right to request any method of NDT for any corrective work performed by the Contractor during the work.
- .6 Contractor's procedures, methods, tools, equipment and qualified personnel that will be implemented to demonstrate compliance with Finishes, including material and product requirements, finish thicknesses, placement tolerances, manufacturer's written instructions, and tolerances.

### 1.05 DELIVERY, STORAGE AND HANDLING

- .1 Inspect each shipment of material and timely replace any damaged materials.
- .2 Unload, handle and store materials in accordance with the manufacturer's written instructions. Do not damage the metal fabrications or shop-applied coatings. Do not store metal fabrications in direct contact with the ground.

## 2 PRODUCTS

### 2.01 MATERIALS

- .1 Steel
  - .1 Steel sections and plates: in accordance with CSA-G40.20 and CSA-G40.21, Grade 350W.
  - .2 Steel plate for lifting lugs: in accordance with CSA G40.21, Grade 350WT, Category 4
  - .3 Hollow structural sections: in accordance with CSA-G40.21, Grade 350W.
  - .4 Steel pipe: in accordance with ASTM A53, weight as specified in Contract Documents.
  - .5 Welding materials in accordance with CSA-W59M. Welding electrodes in accordance with CSA-W48. Welding electrodes for structural steel E480XX.
  - .6 High strength steel bolts in accordance with ASTM A325M, galvanized finish.
  - .7 Steel anchor bolts: in accordance with ASTM A307, galvanized finish.
  - .8 Nuts and washers: hexagon nuts, washers to ASTM F3111.
- .2 Metal components specific to stoplogs
  - .1 Guide shoes: 60 ASCE Rail conforming to ASTM A1.
  - .2 Cap screws: in accordance with ASTM F835, galvanized finish.
  - .3 Stirrup bolts: in accordance with ASTM A490.
  - .4 Clevis pin: headed steel pin conforming to AISI 1035 (min yield strength 370 MPa).
  - .5 Shackles: 44 mm (1-<sup>3</sup>/<sub>4</sub> in.) galvanized bow shackle with a working load limit of 40 tonnes.

- .6 Master link: 44 mm (1- $\frac{3}{4}$  in.) diameter (welded or forged) alloy steel with a working load limit of 38.5 tonnes.
- .7 Wire rope: 6 x 37 galvanized EIPS IWRC with a nominal breaking strength of 139.1 tonnes.
- .8 Sleeve: steel swage type sleeve for Flemish eye wire rope splicing with termination efficiency rating min 92%.
- .9 Thimble: galvanized extra heavy wire rope thimble.

## 2.02 FABRICATION

- .1 Employ a fabricator certified by the Canadian Welding Bureau in accordance with CSA-W47.1, Division 3, unless specified otherwise.
- .2 Fabricate in accordance with CAN/CSA-S16. Perform welding in accordance with CSA-W59M using welding electrodes in accordance with CSA-W48. Control and minimize distortion, and include stress relief measures to minimize residual stresses.
- .3 Do not conduct welding operations when the ambient temperature is below 0°C, or when the base metal temperature is below 0°C. Preheat and maintain the base metal at a minimum temperature of 25°C during welding.
- .4 Accurately fabricate metal fabrications true to line and free form warps, twists, bends, and open joints. Reject metal fabrications that have sharp kinks or bends.
- .5 Use approved dies or bending rolls for bends. When heating is required, avoid overheating the metal and use cooling methods that do not alter the original properties of the metal.
- .6 Do not carry out metal fabrications with welds other than those specified in the Contract Documents unless authorized by the Departmental Representative.
- .7 Structural steel may be gas-cut in accordance with the applicable portions of CAN/CSA-S16. Do not flame-cut any materials without the authorization of the Departmental Representative.
- .8 Provide bolted connections in accordance with the applicable clauses of CAN/CSA-S16.
- .9 Provide holes for fasteners that are not more than 2 mm larger than the nominal diameter of bolts unless otherwise specified in the Contract Documents. Where the thickness of the material is greater than the nominal diameter of the bolt, sub-punch and ream or sub-drill and ream, or drill the holes for the fasteners. Poor matching of holes will be cause for rejection of the item of work. Flame-cutting holes for fasteners shall not be permitted.

## 2.03 FINISHES

- .1 Painting
  - .1 DFT = dry film thickness; VOC = volatile organic content; HAP = hazardous air pollutant.
  - .2 Stoplogs
    - .1 Prepare, prime and paint stoplog steel surfaces, other than galvanized or stainless steel components, after fabrication as follows:

- .2 Service: continuous immersion in fresh water, with mild abrasion.
- .3 Surface Preparation: SSPC SP-10, blast clean to "Near White Metal", surface profile 1.0-2.0 mils maximum.
- .4 Primer Coat: resin type - single component moisture cure aromatic urethane, pigment type - 83% zinc in the dry film, sheen - flat, volume solids - 62% ±2%, VOC < 95.9 g/L (0.8 lbs/gal), HAPs free, 3-5 mils DFT and stripe coat, Standard Grey.
- .5 Intermediate Coat: resin type - single component moisture cure aromatic urethane, pigment type - micaceous iron oxide (419.4 g/L (3.5 lbs/gal)), sheen - flat, volume solids - 62% ±2%, VOC < 95.9 g/L (0.8 lbs/gal), 3-5 mils DFT, Standard Brownish Grey.
- .6 Finish Coat: single component moisture cure aliphatic urethane, pigment type - micaceous iron oxide (419.4 g/L (3.5 lbs/gal)), sheen - semi gloss, volume solids - 63% ±3%, VOC < 95.9 g/L (0.8 lbs/gal), 2-4 mils DFT, Standard Grey.
- .3 Stoplog Lifting Beam
  - .1 Prepare, prime and paint stoplog steel surfaces, other than galvanized or stainless steel components, after fabrication as follows:
    - .2 Service: continuous immersion in fresh water, with mild abrasion.
    - .3 Surface Preparation: SSPC SP-10, blast clean to "Near White Metal", surface profile 1.0-2.0 mils maximum.
    - .4 Primer Coat: resin type - single component moisture cure aromatic urethane, pigment type - 83% zinc in the dry film, sheen - flat, volume solids - 62% ±2%, VOC < 95.9 g/L (0.8 lbs/gal), HAPs free, 3-5 mils DFT and stripe coat, Standard Grey.
    - .5 Intermediate Coat: resin type - single component moisture cure aromatic urethane, pigment type - micaceous iron oxide (419.4 g/L (3.5 lbs/gal)), sheen - flat, volume solids - 62% ±2%, VOC < 95.9 g/L (0.8 lbs/gal), 3-5 mils DFT, Standard Brownish Grey.
    - .6 Finish Coat: single component moisture cure aliphatic urethane, pigment type - organic and inorganic pigment, sheen - semi gloss, volume solids - 63% ±3%, VOC < 95.9 g/L (0.8 lbs/gal), 2-4 mils DFT, Safety Yellow.
- .4 New upper left rack arm
  - .1 Prepare, prime and paint stoplog steel surfaces, other than galvanized or stainless steel components, and other than after fabrication as follows:
    - .2 Service: continuous immersion in fresh water, with mild abrasion.
    - .3 Surface Preparation: SSPC SP-10, blast clean to "Near White Metal", surface profile 1.0-2.0 mils maximum.
    - .4 Primer Coat: resin type - single component moisture cure aromatic urethane, pigment type - 83% zinc in the dry film, sheen - flat, volume solids - 62% ±2%, VOC < 95.9 g/L (0.8 lbs/gal), HAPs free, 3-5 mils DFT and stripe coat, Standard Grey.
    - .5 Intermediate Coat: resin type - single component moisture cure aromatic urethane, pigment type - refined coal tar pitch and micaceous iron oxide, sheen - flat, volume solids - 64% ±2%, VOC < 95.9 g/L (0.8 lbs/gal), 3-5 mils DFT, Black.
    - .6 Finish Coat: resin type - single component moisture cure aromatic urethane, pigment type - refined coal tar pitch and

- micaceous iron oxide, sheen - flat, volume solids - 64% ±2%, VOC < 95.9 g/L (0.8 lbs/gal), 3-5 mils DFT, Black.
- .5 Apply paint and primer in strict accordance with paint manufacturers specifications and recommendations.
  - .6 Incorporate following requirements derived from NACE RPO178(9S) and USA CE EM 1110-2-2702 (2000):
    - .1 Properly detail structural members such that all exposed portions of the structure can be properly prepared and painted.
    - .2 Provide drain holes to prevent entrapment of water.
    - .3 Avoid pockets or crevices that will not drain, and that cannot be properly abrasive blasted and coated.
    - .4 Grind sharp edges and fillets to a smooth radius of at least 3 mm.
    - .5 Provide continuous and smooth welds with no porosity, holes, high spots, lumps or pockets.
    - .6 Grind off weld ends, slag, splatter or any other deposits.
  - .7 Employ only competent, qualified installers, with previous experience on comparable projects.
  - .8 Notify Departmental Representative at least 48 hours prior to any coating application.
  - .9 The Departmental Representative reserves the right to appoint, at the Departmental Representative's expense, a Quality Assurance Representative (QAR) to perform inspection, testing and quality assurance services during painting. Provide free access and assistance to the QAR during such inspection and testing.
  - .10 The coated surface will be considered to lack uniformity, continuity and soundness, and will be rejected if any of the following defects are apparent:
    - .1 Runs, sags, holidays or shadowing.
    - .2 Evidence of poor coverage of plates, lap joints, crevices, pockets, corners and re-entrant angles.
    - .3 Damage to coatings.
  - .11 Undertake paint application no later than 12 hours after commencement of the surface preparation and cleaning operation.
  - .12 Apply paint only under conditions of humidity and of surface and ambient air temperatures which encourage evaporation and do not cause condensation. Ensure surfaces to be coated are completely dry and are maintained at a minimum temperature of 10°C and at least 3°C above the dew point of the surrounding air.
  - .13 Protect newly cleaned or painted surfaces from moisture, condensation, contamination and freezing temperatures until the paint is thoroughly cured in a covered shop. Prevent contamination of surfaces between coats of paint.
  - .14 Wherever possible, apply paint with spray equipment.
  - .15 Do not add thinners to any paint except as recommended by the paint manufacturer and approved by the Departmental Representative. Paint thinners, if used, and solvents must be compatible with the paint materials being applied.
  - .16 Repair damaged areas in strict accordance with the procedures approved by the manufacturer and the Departmental Representative. Remove coating, clean and re-coat surfaces rejected by the Departmental Representative at no additional cost.
- .2 Galvanizing
- .1 Hot-dip galvanize all metal fabrications including embedments, except stainless steel items and those items specified to be painted in Section 2.03.1, in accordance with ASTM A123. Remove and grind smooth

all welding defects. Employ measures to minimize distortions due to galvanizing. Locate vent holes so they are not readily visible after the item is installed. Galvanize all items after fabrication, except parts that are bolted together are to be galvanized before final assembly.

- .2 Repair damaged galvanized surfaces with a zinc-rich paint that is MPI Paint #18 (Primer, Zinc Rich, Organic) or SSPC Paint #20 Zinc Rich Coating Type II Organic. Power tool clean surfaces to be repaired to a bright metal surface. Apply multiple coats of zinc-rich paint in accordance with the manufacturer's written instructions to obtain a minimum dry film thickness of 50 microns or greater where required by the paint manufacturer.

### **3 EXECUTION**

#### **3.01 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from Departmental Representative.

#### **3.02 ERECTION**

- .1 Shop assemble matching parts of metal fabrications to verify the correctness of fabrication and matching of component parts. If required by Departmental Representative, assemble the component parts at the Site prior to installation.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Install anchor bolts such that, after placement of the mortar, their position is within 3 mm of their specified location, and within 2 mm of their specified location with respect to other anchor bolts, which are to be subsequently connected to the same piece of metalwork. Provide templates for proper location of anchor bolts for equipment.
- .4 Install adhesive anchors in accordance with the manufacturer's written instructions. Drill holes to the required diameter and specified embedment depth, and clean out using a wire brush or compressed air, free of oil. Protect anchors and allow adequate cure time for the adhesive prior to applying loads.
- .5 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .6 Supply components for work by other trades in accordance with shop drawings and schedule.

- .7 Make field connections with bolts to CSA S16 or weld field connection.
- .8 Deliver items for casting into concrete together with setting templates to appropriate location and construction personnel.
- .9 Touch-up rivets, field welds, bolts and burnt or scratched surfaces as per coating manufacturer's written instructions as noted in Section 2.03.

### 3.03 TOLERANCES

- .1 Stoplogs
  - .1 Machine seal bearing bar, wall bearing bar and bearing plate faces to obtain the required tolerances.
    - .1 Seal bearing bar to  $\pm 2$  mm over the full length of the stoplog.
    - .2 Mounting surfaces for seals to  $\pm 2$  mm over the full length.
    - .3 Vertical faces of wall bearing bars plumb to within  $\pm 1$  mm over the full height of stoplog.
    - .4 End and intermediate bearing plates to  $+0.5$  mm over the width of the stoplog.
  - .2 Embedded stoplog sill plate and guide slots
    - .1 Machine sealing and bearing faces to obtain the required tolerances.
      - .1 Sill plate to  $\pm 0.5$  mm when checked with a 2 m straight edge; level within  $\pm 2$  mm over the entire length.
      - .2 Vertical guide slot seal face to  $\pm 0.5$  mm when checked with a 2 m straight edge and plumb within  $\pm 3$  mm over the entire length.
      - .3 Lifting beam - depth of built-up section at guide slots  $\pm 2$  mm.
  - .3 Dry testing of stoplogs
    - .1 Insert five stoplogs into the upper stoplog guide slot and four stoplogs into the lower stoplog guide slot and verify the following tolerances are achieved:
      - .1 No gaps between bottom stoplogs and stoplog seal plates, and no horizontal gaps larger than 0.1 mm between individual stoplogs.
    - .2 Demonstrate stoplog tolerances have been achieved to Departmental Representative prior to removing stoplogs or demobilizing equipment.

### 3.04 STOPLOG STORAGE

- .1 Upon successful testing of stoplogs, remove stoplogs from slots and transport to approved storage location as specified by the Departmental Representative; assume the storage area is on the east side of the river. Transport and store the stoplog lifting beam in an approved indoor storage area as specified by the Departmental Representative.
- .2 Stoplogs to be stored in five neatly arranged rows with stoplogs stacked two high. Lower stoplog to be blocked with minimum 6" x 6" pressure treated lumber (minimum 5 support blocks per stoplog). Provide treated 2" x 6" pressure treated lumber to block between the lower and upper stoplogs (minimum 5 support blocks per stoplog). No blocks are to be in contact with the gate seals.

### 3.05 OPERATING T-WRENCH

- .1 Design, fabricate and supply two operating t-wrenches to allow for manual operation of the lock gate.

- .2 Refer to "St. Andrews Rapids Lock Socket for Turning Lever" Drawing included in the information documents for an example of the original design.
- .3 New operating T-Wrench to be a "T" design constructed of heavy-duty pipe (e.g. 150 mm diameter shaft and 100 mm diameter handle) with the T-handle positioned at 1250 mm from the base. T-handle to be no less than 2200 mm long.
- .4 Confirm operating nut dimensions and field verify required operating torque prior to design, shop drawing development and fabrication.

### 3.06 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installation.

**END OF SECTION**