

SECTION 05590 - STRUCTURAL METALS

PART 1 - GENERAL

1.1 SCOPE

- A. This section covers the fabrication and erection of structural metal items.
- B. Except as otherwise specified or indicated on the Drawings, all work shall conform to the applicable provisions of the AISC “Steel Construction Manual” (15th edition) with the exception of the “Code of Standard Practice for Steel Buildings and Bridges”; and the Aluminum Association “Specification for Aluminum Structures.”
- C. Special inspection during the fabrication and erection of structural steel, if required by the local building code, is addressed in the Code-Required Special Inspections and Procedures section.
- D. Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

1.2 SUBMITTALS

- A. Drawings and Data - General
 - 1. Complete data, fabrication drawings, and setting or erection drawings covering all structural and miscellaneous metal items shall be submitted in accordance with the Submittals Procedures section.
- B. Connection and Weld Data
 - 1. All bolted connections and welds shall be properly identified on the shop drawings. Welding procedures, welding procedure qualification records and welder qualifications shall be submitted.
- C. Bolts and Washer Data
 - 1. Submittals for high strength bolts, tension control bolts and load indicator washers shall include statements from the bolt and washer manufacturers certifying satisfactory compliance with the governing standards and the specified tests.
- D. Drawings and Data – Design
 - 1. Submittals for items that are designed by the fabricator shall include drawings sealed by a professional engineer registered in the state of the project. Data shall include confirmation that the design meets all applicable code requirements. Calculations shall be submitted when requested by Engineer.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be handled, transported, and delivered in a manner which will prevent bends, dents, significant coating damage, or corrosion. Damaged materials shall be promptly replaced. Structural metal work shall be stored on blocking so that no metal touches the ground and water cannot collect thereon. The material shall be protected against bending under its own weight or superimposed loads.
- B. Bolting materials shall be stored indoors. Weld rod shall be stored in accordance with the supplier's instructions and AWS D1.1.

1.4 FABRICATOR QUALIFICATION

- A. All fabricating plants providing structural steel shall be qualified fabricators who participate in the AISC Certification program and are designated an AISC Certified Plant, Category BU.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials needed for both shop and field assembly shall be furnished.

2.2 MATERIALS

Steel

Shapes (W, WT)	ASTM A992.
Shapes (S, M, HP, C)	ASTM A36 or ASTM A572 Grade 50.
Other Shapes (angles)	ASTM A36.
Plates and Bars	ASTM A36.
Sheets	ASTM A1008 CS Type B or A1011 CS Type B.
Pipe	ASTM A53, Type E or S, Grade B ($F_y = 35$ ksi).
Round Structural Tubing	ASTM A500, Grade C ($F_y = 46$ ksi).
Square and Rectangular Structural Tubing	ASTM A500, Grade C ($F_y = 50$ ksi).

Bolts and Nuts

Bolts, High Strength	ASTM F3125, Grade A325.
Bolts, Tension Control Type (Twist off)	ASTM F3125, Grade 1852.
Bolts, unfinished	ASTM A307.
Nuts, Heavy-Hex	ASTM A563, grade and finish compatible with bolts.

Nuts, Self-Locking	Prevailing torque type; IFI-100, Grade A.
Washers	
Flat, Hardened	ASTM F436, Type 1.
Lock	ANSI/ASME B18.21.1, helical spring type.
Beveled	ASTM F436.
Load Indicator	ASTM F959, compressible-washer-type direct tension indicator; type compatible with bolts tested in accordance with Article 10.2 of ASTM F959.
Threaded Rods (Including Hanger Rods for Pipe Supports)	ASTM A36. Threaded rods shall have sufficient threading to permit the maximum adjustment available. Continuously threaded rod is not acceptable for rods over 12 inches in length.
Forged Steel Sleeve Nuts	AISI C-1018, Grade 2.
Stainless Steel	
Shapes	ASTM A1069 or A276, Type 316L.
Plates	ASTM A240, Type 316L.
Pipe	ASTM A312, Grade TP316L.
Tube	ASTM A269, Grade TP316L.
Bolts	ASTM F593, Alloy Group 1 or 2, minimum yield strength of 45 ksi.
Nuts	ASTM F594, Alloy Group shall match that of the bolts. Nuts shall have a minimum proof stress equal to or greater than the minimum full-size tensile strength of the bolts.
Washers	
Flat	ANSI/ASME B18.22.1, Type 316.
Lock	ANSI/ASME B18.21.1, helical spring type, Type 316.
Threaded Rods (Including Hanger Rods for Pipe Supports)	ASTM A593, Alloy Group 1 or 2, minimum yield strength of 45 ksi.
Weld Metal (Steel Connections)	ANSI/AWS D1.1, Table 3.1, filler metal with minimum 70 ksi tensile strength unless otherwise required.
Rails	
Crane	ASTM A1.
Railroad	ASTM A1.
Shop Coatings	
Universal Primer	As indicated in the Protective Coatings section.

Bituminous Paint
Galvanizing

Metal fabricator's standard product.
ASTM A123, A153, A385, and F2329 as applicable.

2.3 CRANE SYSTEMS

- A. Steel beams used as underhung crane or hoist runways shall be straight and level. The upper surface of the lower flange of each beam shall be smooth, with all projections ground off. Joints shall be close-fitting and free from unevenness. The beams shall be rigidly supported in exact alignment. A section of each runway beam shall not be installed until after the crane or hoist has been installed.
- B. Stops as recommended by the crane or hoist manufacturer shall be bolted in place on each end of each runway beam to limit the travel of the crane or hoist. Stops shall be so located that the crane or hoist does not come into contact with any part of the structure or piping. If the crane or hoist is required to be powered, at the power feed end of the runway the stops shall be designed so that the cable trolleys will pass beneath the stops. The stops shall be so located that there is sufficient room on the runway for storage of the cable trolleys beyond the stops. Secondary stops shall be provided for the cable trolleys.
- C. Crane Rails
 - 1. Rails on which a traveling, top running crane is to travel shall be furnished complete with clamps or hook bolts, splice plates, stops, anchor bolts and nuts, and other accessories necessary to complete the installation indicated on the Drawings.

2.4 STRUCTURAL STEEL BOLTED CONNECTIONS

- A. Bolt holes shall have a diameter nominally 1/16 inch larger than the nominal bolt diameter. Bolt holes for one ply of vertical diagonal bracing connections may be oversized to a diameter nominally 3/16 inch larger than the nominal bolt diameter.

2.5 SHOP COATING

- A. All items shall be shop coated as specified herein. The requirements for field painting are covered in the Protective Coatings section.
- B. Contact surfaces of structural steel slip critical bolted connections shall not be shop coated. Contact surfaces of structural steel bearing type bolted connections may be shop coated.
- C. Cleaning
 - 1. Surfaces shall be dry and of proper temperature when coated, and shall be free of grease, oil, dirt, dust, grit, rust, loose mill scale, weld flux, slag, weld spatter, and other objectionable substances. Articles to be galvanized shall be pickled before galvanizing. All other ferrous metal surfaces shall be cleaned by solvent, high-speed power wire brushing or by blasting to the extent recommended by the paint manufacturer and as required in the Protective Coatings section.

D. Edge Grinding

1. Sharp projections of cut or sheared edges of ferrous metals which will be submerged in operation, except for items specified to be hot-dip galvanized, shall be ground to a radius as needed to ensure satisfactory paint adherence and as required in the Protective Coatings section.

E. Prime Painted Steel

1. Unless otherwise specified or indicated on the Drawings, all ungalvanized steel shall be given a shop coat of universal primer after fabrication. The dry film thickness of the universal primer shall be at least 5 mils. Steel surfaces shall be prime-coated as soon as practicable after cleaning. Steel shall not be moved or handled until the shop coat is dry and hard.

F. Galvanizing

1. Steel materials required to be galvanized are indicated on the Drawings. All galvanizing shall be done by the hot-dip process after fabrication. An approved zinc-rich paint shall be used to touch up minor coating damage, in accordance with ASTM A780. Materials with significant coating damage shall be regalvanized or replaced.
2. Bolts, nuts, and washers shall be galvanized when connected materials are galvanized or where indicated on the Drawings. The use of zinc-plated bolts will not be acceptable.

G. Stainless Steel

1. Unless otherwise specified, all items fabricated from stainless steel shall be thoroughly cleaned and degreased after fabrication. Pickling or a light blast cleaning shall produce a modest etch and remove all embedded iron and heat tint. Surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron and shall be retreated as needed to remove all traces of iron contamination. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

PART 3 - EXECUTION

3.1 STRUCTURAL STEEL ERECTION

- A. Structural steel shall be erected so that individual pieces are plumb, level, and aligned within a tolerance of 1:500. The elevations of the top of floor and roof members shall be within 1/16 inch of the elevations indicated on the Drawings. The faces of girts and other supporting members for rigid wall panels shall be in vertical planes within a maximum variation of 1/8 inch.
- B. All members and parts, as erected, shall be free of warps, local deformations, and unauthorized bends. All parts shall be assembled accurately as indicated on the Drawings. Light drifting will be permitted to draw parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with

twist drills and only with the approval of Engineer. Enlarging holes by burning will not be permitted.

C. Baseplates shall be set level in exact position and grouted in place.

D. Inspection and Testing

1. Special inspection will be performed as indicated in the Code Required Special Inspections and Procedures section. The erector shall provide access as needed to facilitate all inspections and shall provide timely notification during erection when inspection milestones are approaching.

E. Crane Rails

1. Crane rails shall be installed level and in accurate alignment and shall form a continuous, smooth track. Rail installation tolerances shall be in accordance with CMAA Specification 70.

3.2 STRUCTURAL STEEL BOLTED CONNECTIONS

- A. Unless otherwise indicated on the Drawings, bolted connections for structural steel, as defined in the AISC manual, shall be made with ASTM F3125 high strength bolts conforming to the “Specification for Structural Joints Using High-Strength Bolts” as approved by the Research Council on Structural Connections. The method of installation, pretensioning procedures, bolting equipment and tools shall likewise conform to the above referenced standard.
- B. When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts, or washers, shall be free of loose mill scale, dirt, burrs, oil, and other foreign material that would prevent solid seating of the parts.
- C. Beveled washers shall be used when the bearing faces of bolted parts have a slope of 1:20 or greater with respect to a plane perpendicular to the bolt axis. Bolt length shall be increased as needed to accommodate the beveled washers.
- D. Tightening of each connection assembly shall progress systematically from the most rigid part of the joint toward the free edges until all have been sufficiently rotated or the load indicator washers on all bolts have been closed to the average gap stipulated by the load indicator washer manufacturer.
- E. Except as otherwise indicated on the Drawings or specified herein, bolted connections shall be bearing type with threads excluded from the shear plane. Slip critical connections shall be used in diagonal bracing connections, where oversize holes or slotted holes parallel to the direction of the load are used, and where indicated on the Drawings.
- F. Bolts in all structural steel connections, both bearing and slip critical, shall be fully pretensioned in accordance with the AISC standards unless specifically noted otherwise on the Drawings. The calibrated wrench method of pretensioning bolts will not be acceptable. Acceptable pretensioning methods are as follows:

Connection Type	Acceptable Pretensioning Method
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Bearing	Turn of the nut method and load-indicator washers are acceptable. Tension control (twist-off) type bolts may be used only if approved by Engineer.
Slip-Critical	Load indicator washers.

G. Turn of the Nut Method

1. The bolt, nut, and material shall be match marked. A wax lumber marker or paint shall be used to clearly mark the assembly.

H. Load-Indicator Washers

1. Load indicator washers shall be installed in accordance with the manufacturer's recommendations, as supplemented herein. To facilitate proper tightening of fastener assemblies with load indicator washers, a hardened flat washer shall be installed under the turned element (bolt head or nut) and between the turned element and the load indicator washer protrusions, in all cases. Whenever possible, the load indicator washer shall be installed on the head end of the bolt. If the bolt head will not be visible for inspection of the indicator washer after installation, or if the bolt head must be turned to tighten the assembly, the load indicator washer may be installed on the nut end of the bolt.

I. Tension Control (Twist-off) Bolts

1. Patented tension control bolts shall be of equivalent size and strength to the indicated high strength bolts, and shall be installed in strict accordance with the manufacturer's instructions. Load-indicator washers are not required on tension control bolts.

3.3 STRUCTURAL AND STAINLESS STEEL WELDING

- A. Welding and related operations shall conform to applicable provisions of AWS D1.1 for steel and AWS D1.6 for stainless steel. All welding shall be performed in accordance with written procedures, using only those joint details which have prequalified status. All welding shall be performed by welders qualified in accordance with the American Welding Society.
- B. Welds not dimensioned on the Drawings shall be sized to develop the full strength of the least strength component of the connection.
- C. All butt and miter welds shall be continuous and, where exposed to view, shall be ground smooth. Intermittent welds shall have an effective length of at least 2 inches and shall be spaced not more than 6 inches apart.
- D. Surfaces within 2 inches of a weld shall be free from loose or thick scale, slag, rust, moisture, grease, paint and other foreign materials that would prevent proper welding or release objectionable fumes.
- E. Only shielded metal arc, gas metal arc, flux cored arc, submerged arc, and gas tungsten arc welding are permitted. For flux cored arc welding, only E70xx one (1) or five (5) wire electrodes with supplemental gas shielding shall be permitted. Use of electroslog or electrogas

welding processes or the short-circuiting transfer mode of the gas metal arc process will not be acceptable.

- F. Field welded connections shall not be substituted for field bolted connections indicated on the Drawings.

End of Section