

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Structural Steel for Bridges.
- B. Structural Steel for Buildings and Other Structures.
- C. Structural Tubing.
- D. Pipe.
- E. Steel Pins.
- F. Anchors and Fasteners.
- G. Stud Shear Connectors.
- H. Forgings.
- I. Castings.

1.02 MEASUREMENT AND PAYMENT

- A. General: Measurement and payment for structural steel will be either by the lump-sum method or by the unit-price method as determined by the listing of the bid item for structural steel indicated in the Bid Schedule of the Bid Form.
- B. Lump Sum: If the Bid Schedule indicates a lump sum for structural steel, the lump-sum method of measurement and payment will be in accordance with Section 01 20 00, Price and Payment Procedures, Article 1.03.
- C. Unit Price: If the Bid Schedule indicates a unit price for structural steel, the unit-price method of measurement and payment will be as follows:
 - 1. Measurement:
 - a. Structural steel will be measured for payment by the pound or by the ton, calculated without deduction for holes under 12 inches in longest dimension, for each item, type, and grade of structural steel installed complete in place. Weights will be calculated in accordance with AISC “Code of Standard Practice for Steel Buildings and Bridges”.
 - b. Stud shear connectors, shims, wedges, fasteners, shop and field touchup painting, and non-shrink grout for base or bearing plates will not be measured separately for payment. All costs in connection therewith will be considered incidental to and included with the applicable items of structural steelwork.

2. Payment: Structural steel will be paid for at the indicated Contract unit prices for the computed quantities as determined by the measurement method specified in Article 1.02.C.1.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)/American Institute of Steel Construction (AISC):
 1. AISC Steel Construction Manual
 2. ANSI/AISC 303 Code of Standard Practice for Steel Buildings and Bridges
 3. AISC RCSC Specifications for Structural Joints Using High-Strength Bolts
 4. ANSI/AISC 341 Seismic Provisions for Structural Steel Buildings
 5. ANSI/AISC 360 Specifications for Structural Steel Buildings
 6. AISC 348 Specification for Structural Joints Using High-Strength Bolts
- B. American Railway Engineering and Maintenance of Way Association (AREMA):
 1. Manual for Railway Engineering (Fixed Properties), herein referred to as the "AREMA Manual", Chapter 15, "Steel Structures"
- C. American Society for Testing and Materials (ASTM):
 1. ASTM A6/A6M Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
 2. ASTM A27/A27M Standard Specification for Steel Castings, Carbon, for General Application
 3. ASTM A36/A36M Standard Specification for Carbon Structural Steel
 4. ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings
 5. ASTM A48/A48M Standard Specification for Gray Iron Castings
 6. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 7. ASTM A108 Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished
 8. ASTM A148/A148M Standard Specification for Steel Castings, High-Strength, for Structural Purposes

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9. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
10. ASTM A194/A194M Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
11. ASTM A242/A242M Standard Specification for High-Strength Low-Alloy Structural Steel
12. ASTM A307 Standard Specification For Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength
13. ASTM A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
14. ASTM A449 Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
15. ASTM A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
16. ASTM A501/A501M Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
17. ASTM A514/A514M Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
18. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
19. ASTM A572/ A572M Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
20. ASTM A588/ A588M Standard Specification for High-Strength Low-Alloy Structural Steel up to 50 ksi (345 MPa) Minimum Yield Point with Atmospheric Corrosion Resistance
21. ASTM A618/A618M Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
22. ASTM A668/ A668M Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
23. ASTM A673/A673M Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
24. ASTM A709/A709M Standard Specification for Structural Steel for Bridges
25. ASTM D4285 Standard Test Method for Indicating Oil or Water in Compressed Air

- 26. ASTM F436/F436M Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
 - 27. ASTM F959 Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
 - 28. ASTM F3125/F3125M Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
- D. American Welding Society (AWS):
- 1. AWS A2.4 Standard Symbols for Welding, Brazing and Nondestructive Examination
 - 2. AWS D1.1/D1.1M Structural Welding Code – Steel
 - 3. AWS D1.5M/D1.5 Bridge Welding Code
- E. The Society for Protective Coatings (SSPC):
- 1. SSPC-SP 1 Solvent Cleaning
 - 2. SSPC-SP 3 Power Tool Cleaning
 - 3. SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning
 - 4. SSPC-SP 10/NACE No. 2 Near-White Blast Cleaning
 - 5. SSPC-SP 11 Power Tool Cleaning to Bare Metal
 - 6. SSPC-PA 1 Shop, Field, and Maintenance Painting of Steel
 - 7. SSPC-Paint 20 Zinc-Rich Coating (Type I – Inorganic and Type II – Organic)
 - 8. SSPC-Paint 42 Epoxy Polyamide/Polyamidoamine Primer, Performance-Based

1.04 REGULATORY REQUIREMENTS:

- A. The regulatory requirements which govern the work of this Section include the following governing code:

California Code of Regulations (CCR), Title 24, Part 2, California Building Code, Chapter 22, “Steel”, and Chapter 22A, “Steel”.

1.05 SUBMITTALS

- A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Shop Drawings:
1. Submit detailed Shop Drawings of structural steel work prior to fabrication, showing sizes, details of fabrication and construction, methods of assembly, locations of hardware, anchors, and accessories, and erection sequence and details. Include procedures for heavy lifts and rigging. Erection drawings shall be referenced to the Contract Drawings.
 2. Shop Drawings shall include member identity, welding technique, cuts, copes, gussets, connections, holes, fasteners, camber, fabrication and erection tolerances, type of finish, paint system, weights of members, and critical clearances.
 3. Welds, both shop and field, shall be indicated by standard welding symbols of AWS A2.4. Drawings shall show the size, length, and type of each weld.
 - a. Indicate individual welders' identification (I.D.) on project record drawings.
 4. Investigate stresses caused by the proposed erection procedure. Submit drawings showing details of required temporary supports, staying, and bracing. Include descriptive data and design calculations, to illustrate the erection, transportation, and handling procedures, including sequence of erecting and transfer of loads if applicable.
 5. Furnish setting diagrams, templates, and directions for the erection of structural framing, anchor bolts, bearing plates, and other embedded items.
 6. The Contractor shall be responsible for errors of fabrication and for correct fitting of structural members.
- C. Detailing Requirements: Requirements for the detailing of structural steel work are specified herein under Part 2 – Products because of the close relationship of detailing with fabrication requirements.
- D. Product Data: Submit manufacturer's product data of load-indicator washers (Compressible-Washer-type direct tension indicators) when proposed for use.
- E. Mill Test Reports:
1. Submit certified mill test reports of structural steel materials, covering chemical analysis and physical properties of each heat of steel from which the material for structural steel will be furnished, in conformance with the hereinafter specified ASTM Specifications.
 2. Steel materials which are not properly certified as conforming with specified ASTM Specifications will be rejected.

- F. Welding Records and Data: Refer to Section 05 05 22, Metal Welding, for requirements.

1.06 QUALITY ASSURANCE

- A. Fabricator's Shop or Facility: Fabricator's shop or facility will be inspected and approved by the Engineer before the start of fabrication work. Notify the Engineer in writing at least ten Days before the scheduled start of fabrication work. Fabrication of structural steel shall be performed by an approved fabricator at an approved facility.
- B. Indicated Dimensions: Unless otherwise indicated, dimensions at expansion joints and similar construction were determined for a temperature of 50 degrees Fahrenheit. Make proper adjustments for temperature when the structure is to be fabricated and installed at any other temperature.
- C. Tolerances:
 - 1. Variation of camber from indicated dimensions:
 - a. Structural rolled beams directly supporting bridge deck: minus zero, plus 1/2 inch for beams 50 feet and shorter, with an additional tolerance of plus 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
 - b. Welded plate girders: Conform with requirements of AWS D1.1/D1.1M, Article 5.22, Dimensional Tolerance of Welded Structural Members.
 - 2. Measure camber with beam or girder in a no-load position (laid on its side).
- D. Calibration of Torque Wrenches:
 - 1. The calibrating device for setting calibrated torque wrenches shall be checked for accuracy by the Contractor's qualified personnel not more than 30 Days prior to its first use on the work, and at intervals not more than six months thereafter.
 - 2. If the Engineer has reason to question the accuracy of the calibrating device, the Engineer may require that it be returned to the manufacturer for certification of its accuracy.
 - 3. Calibrate torque wrenches as specified in AISC 348.
- E. Qualifications of Welders and Welding Procedures: Refer to Section 05 05 22, Metal Welding, for requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Avoid bending, scraping, and overstressing the steelwork. Block with wood, or otherwise protect, projecting parts which may be bent or damaged.
- B. Mark weight and piece (mark) number, corresponding to shop erection sequence drawing, on all members. Match-mark all shop pre-fitted members.

- C. Ship small parts, such as bolts, nuts, washers, pins, fillers, clips, and small connecting plates and anchors, in boxes, crates, or barrels. Pack separately each length and diameter of bolt and each size of nut and washer. Plainly mark an itemized list and description of the contents on the outside of each container.
- D. Load, transport, unload, and store structural steel materials in such a manner that the metal is kept clean and free from injury. Store materials above ground on platforms, skids, or other supports, and cover and protect from corrosion.
- E. Handle and store beams and girders in such a manner that they will have the required camber after erection.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Manufactured steel clips and angles will be accepted where such will meet the requirements of the Contract Drawings and are shown on the Shop Drawings.
- B. Structural Steel for Bridges: ASTM A709/A709M, Grade 36, 36T2, 50T2, or 50WT2, as indicated.
 - 1. Identify all materials by heat and lot, if applicable. Correlate with certified mill test reports.
 - 2. Impact Test Qualification: Specific test requirements for Charpy impact testing for grades 36T2, 50T2, and 50WT2 shall be as follows:
 - a. Sampling and Testing Procedures: ASTM A370 and ASTM A673/A673M, as applicable.
 - b. Frequency of Testing: H.
 - c. Test Temperature: 40 degrees Fahrenheit.
 - d. Condition of Material: As-rolled.
 - e. Orientation of Test Bars: Longitudinal to the direction of final rolling.
 - f. Absorbed Energy Requirements:
 - 1) Normal-strength steel to 4 inches thick and high-strength steel to 2 inches thick for welded construction and to 4 inches thick for bolted construction: 15 ft-lbf.
 - 2) High-strength steel, 2 inches to 4 inches thick, for welded construction: 20 ft-lbf.
 - 3) Subsize Specimens: 12.5 ft-lbf for 10 mm by 7.5 mm specimens, and 10 ft-lbf for 10 mm by 5 mm specimens.
- C. Structural Steel for Buildings and Other Structures:
 - 1. Structural Steel: ASTM A572/A572M, Grade 50, or ASTM A36/A36M

2. High-Strength Steel: ASTM A242/A242M, A572/A572M or A588/A588M, grade or type as indicated.
 3. High-Strength Plate for Welding: ASTM A514/A514M.
 4. Impact Tests: For rolled shapes of ASTM A6/A6M Groups 4 and 5, shapes built-up by welding plates 2 inches thick or thicker, and supplied weld filler metals subject to tensile stresses, shall be furnished with Charpy V-notch testing in accordance with ASTM A6/A6M, Supplementary Requirements, S5. Charpy impact testing shall be in accordance with ASTM A370 and A673/A673M and as specified herein.
- D. Structural Tubing:
1. Cold-Formed Carbon Steel: ASTM A500/A500M, Grade B or as indicated.
 2. Hot-Formed Carbon Steel: ASTM A501/A501M, minimum yield point of 36,000 psi.
 3. High-Strength, Low-Alloy Steel: ASTM A618/A618M, Grade as indicated.
- E. Pipe: ASTM A53/A53M, Type E or Type S, Grade B (minimum yield point of 35,000 psi).
- F. Steel Pins:
1. Greater than 9 inches in diameter: ASTM A668/A668M, Class B, C, or D.
 2. 9 inches and less in diameter: ASTM A668/A668M, Class B, C, or D, or ASTM A108, Grades 1016 through 1030.
- G. Anchors and Fasteners:
1. Anchors, Bolts, Nuts, and Washers: Bolts and studs, nuts, and washers shall conform with ASTM A307, Grade A, and ASTM A449, A563, and F436/F436M, as applicable. Bolts and studs, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A153/A153M, except bolts, nuts, and washers for structural steel shall be machined items without protective coatings.
 2. High-Strength Bolted Connections: Slip-critical type, high-strength bolts. All other threaded fasteners: Furnished with locking hardware.
 3. High-Strength Carbon Steel Bolts: ASTM F3125/F3125M, Type 1; except provide Type 3 for corrosion-resistant steel.
 4. High-Strength Alloy Steel Bolts: ASTM F3125/F3125M, Type 1; except provide Type 3 for corrosion-resistant steel.
 5. Heavy-Duty Hardened Hex Nuts and Washers:
 - a. Nuts:

- 1) For Type 1 Bolts: ASTM A194/A194M, Grade 2H, or ASTM A563, Grade DH.
- 2) For Type 3 Bolts: ASTM A563, Grade C3 or DH3.
- b. Washers: ASTM F436/F436M, for use with ASTM F3125/F3125M bolts, as applicable.
- 6. Load-Indicator Washers: ASTM F959, for use with ASTM F3125/F3125M bolts, as applicable.
- 7. Lubricant for Bolts: Molybdenum disulfide base.

H. Stud Shear Connectors:

- 1. Stud connectors shall be produced by cold heading, cold rolling, or cold machining. Finished stud connectors shall be uniform quality and free of injurious laps, fins, seams, cracks, twists, bends, or other defects. Studs shall not have cracks or bursts deeper than one-half the thickness from the periphery of the head to the shaft. Tensile strength of stud connectors shall be determined by tests of bar stock after drawing or of full diameter finished studs. Strength requirements shall conform to the following:

Tensile Strength (min.)	Elongation (min.)	Reduction of Area (min.)
60,000 psi	20 percent in 2 inches	50 percent

- 2. Stud connectors shall be furnished with arc shields (ferrules) of heat-resistant ceramic or other suitable material for welding.

I. Forgings: ASTM A668/A668M, Class C for carbon steel and Class G for alloy steel.

J. Castings:

- 1. High-Strength Steel: ASTM A148/A148M, grade as indicated.
- 2. Mild-to-Medium-Strength Carbon Steel: ASTM A27/A27M, grade as indicated.
- 3. Malleable Iron: ASTM A47/A47M, Grade 35018.
- 4. Gray Iron: ASTM A48/A48M, Class 30B.

K. Welding Electrodes: Refer to Section 05 05 22, Metal Welding, for requirements.

L. Open-Web Steel Joists: Refer to Section 05 21 00, Steel Joist Framing, for requirements.

M. Shop Painting Materials: As herein specified under Article 2.04.

N. Grout: Provide high-strength, non-shrink grout for base plates in accordance with the requirements of Section 03 61 11, Non-Shrink Grout.

2.02 DETAILING REQUIREMENTS**A. Detailing Standards:**

1. Except as specified otherwise herein or as indicated otherwise on the Contract Drawings, detailing and tolerances shall conform with applicable requirements of AISC Steel Construction Manual, ANSI/AISC 360 and ANSI/AISC 303.
2. Special seismic detailing provisions shall conform with ANSI/AISC 341.
3. Items to be galvanized shall be detailed as specified in Section 05 50 00, Metal Fabrications.

B. Required Provisions:

1. All working points indicated on the Contract Drawings shall be adhered to in the detailing of the work.
2. Substitutions of sections shall be made only as approved by the Engineer.
3. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members.
4. Detail and fabricate work with suitable drain and vent holes as required to provide positive drainage and to prevent the trapping of moisture and stagnant air.

C. Connections:

1. Connections shall be as indicated and as specified herein.
2. Furnish all bolts and bolt placement lists for field and shop connections, including all temporary carbon steel erection bolts and clips required for field erection.
3. Except as otherwise indicated, all connections shall be shop welded and field bolted. Field welded connections will be permitted only where indicated on the Contract Drawings or where specifically approved by the Engineer in writing.
4. Bolted connections shall be made with 3/4-inch or 7/8-inch diameter bolts as specified in ASTM F3125/F3125M, unless otherwise indicated. Tapered washers shall be provided on bolted connections to channels and other structural shapes with sloping flanges.
5. Framed beam connections which are not detailed or otherwise indicated shall be shop welded and field bolted in accordance with AISC Steel Construction Manual, ANSI/AISC 341 and ANSI/AISC 360.
6. Detail field splice connections to develop the full strength of the section in which the splice is made.
7. All joints made with high strength bolts shall be considered to be bearing-type connections with threads included in the plane of shear, except moment-resisting

joints and connection joints where slip-critical type high-strength bolts are required.

2.03 FABRICATION

- A. Structural steelwork shall conform with the applicable requirements of the California Building Code, ANSI/AISC 341 and ANSI/AISC 360. Structural steelwork for railroad and transit rail bridges shall conform with applicable requirements of the AREMA Manual.
- B. Welding and welded connections shall conform with the requirements of Section 05 05 22, Metal Welding.
- C. Steel members and metal fabrications shall be prefabricated and preassembled in the factory or shop as far as practicable.
- D. Form and fabricate the work to meet installation conditions. Include accessories to adequately secure the work in place.
- E. Cutting, drilling, punching, and welding shall be neatly performed with burrs and rough edges removed. Remove all weld flux.
- F. Straighten rolled material, if necessary, before it is laid out for fabrication, in a manner conforming to the mill tolerances specified in ASTM A6/A6M, and by a process and in a manner which will not injure the material. Sharp kinks and bends will be cause for rejection of the material. Heat shrinking of low-alloy structural steel will not be permitted.
- G. Perform shearing, flame cutting, and chipping carefully and accurately so as not to induce residual stress in the metal being cut. The radii of re-entrant gas-cut fillets shall be not less than 3/4 inch and as much larger as practicable. Perform flame cutting in such manner that metal being cut is not carrying stress. Cut edges exposed in the finished work shall be machine cut, sheared, or flame cut, and ground flush. All working points shall be maintained.
- H. Fabricate bearing stiffeners and stiffeners intended as supports for concentrated loads as indicated. Mill or grind bearing surfaces of these stiffeners.
- I. Bend load-carrying cold-rolled steel plates cold at right angles to the direction of rolling. The radius of bend, measured to the concave face of the metal, shall be not less than indicated in the following table, in which T is the thickness of the plate.

Angle Through Which Plate is Bent	Minimum Radius
61 to 120 degrees	1.0 T
121 to 150 degrees	2.0 T

- 1. If a shorter radius is indicated, bend the plate hot. Before bending, round plate edges, where bending occurs, to a radius of 1/16 inch.

- J. Connections shall be bolted or welded as indicated.
- K. Holes shall be drilled or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Holes in base or bearing plates shall be drilled. Holes shall be provided in members to permit connecting the work of other trades. Holes shall be punched or drilled at 1/16 inch larger than the diameter of the bolt.
- L. For high-strength bolting, assemble joints and install bolts in accordance with AISC 348. Hardened-face washers shall be used for all connections using ASTM F3125/F3125M bolts. Assembly of joints using load-indicator washers shall conform to ASTM F959. High-strength bolting will be inspected by a qualified inspector employed by the Contractor's testing laboratory.
- M. For items bearing on concrete, provide steel bearing plates and anchors as indicated. Base or bearing plates shall be leveled by means of adjustment nuts. Templates shall be furnished, together with instructions for setting of anchors, anchor bolts, and bearing plates. Contractor shall assure that anchors and related items are properly set in concrete during the progress of the work.
- N. Fabricate metal bearing surfaces which will come in contact with preformed elastomeric bearing pads or grout, flat to within 1/8 inch tolerance in 12 inches and to within 3/16 inch overall.
- O. Include reinforcing angles, clip angles, plates, punched straps, brackets, and hangers as required to complete the work as indicated.
- P. Provide drainage holes in structural components where water may accumulate without escape.
- Q. Fabricate architecturally exposed structural steel members straight within one-half of the standard camber and sweep tolerances permitted by ASTM A6/A6M.

2.04 CLEANING AND PAINTING

- A. Interior, Non-Corrosive Applications:
 - 1. After fabrication and immediately before shop painting, structural steel materials shall be washed with solvent to remove dust and residue in accordance with SSPC-SP 1.
 - a. Structural steel materials not exposed to the public shall be power-tool cleaned in accordance with SSPC-SP 3 to remove mill scale, rust, grease, oil, and any other foreign matter.
 - b. Structural steel materials exposed to public view shall be blast cleaned in accordance with SSPC-SP 10/NACE No. 2 or power-tool cleaned in accordance with SSPC-SP 11 to remove all visible mill scale, rust, grease, oil, and any other foreign matter.
 - 2. If materials are not painted immediately after cleaning then those materials shall be washed with solvent to remove dust and residue in accordance with SSPC-SP 1.

3. After preparation, steel materials shall be shop painted with one coat of corrosion-inhibitive metal primer in accordance with SSPC PA 1. Materials and application shall conform with SSPC-Paint 20 or SSPC-Paint 42.

B. Exterior Applications:

1. Steelwork to be exposed to weather shall be blast cleaned in accordance with SSPC-SP 10/NACE No.02, Near-White Blast Cleaning, or power-tool cleaned in accordance with SSPC-SP 11, Power Tool Cleaning to Bare Metal. For new steel bridges, cleaning shall be in accordance with SSPC-SP 10/NACE No. 2.
2. After cleaning, solvent wash in accordance with SSPC-SP 1, and shop paint steelwork in accordance with SSPC-PA 1. Materials and application shall conform with SSPC-Paint 20, Zinc-Rich Coatings, Type I – Inorganic or Type II – Organic. For new steel bridges, only shop-applied Type I – Inorganic Zinc Rich Primers shall be used.
3. Where steel components are indicated to be galvanized, comply with galvanizing requirements of Section 05 50 00, Metal Fabrications.
 - a. Galvanized components shall be prepared and painted in accordance with the requirements for cleaning and painting in Section 05 50 00, Metal Fabrication.

C. Steel Materials to Receive Spray-Applied Fireproofing:

1. Steel materials shall be power-tool cleaned in accordance with SSPC-SP 3 to remove mill scale, rust, grease, oil, and any other foreign matter. Welds shall thoroughly wire brushed.
2. After cleaning and just before delivery of steel to the jobsite, steel materials shall be washed with solvent to remove dust and residue in accordance with SSPC-SP 1.
3. Steel materials to receive spray-applied fireproofing shall be shop painted with a primer if recommended by the manufacturer of the fireproofing material, and the primer shall be approved by the manufacturer of the fireproofing material.

D. Steel Materials to Receive Intumescent Fireproofing:

1. Interior steel materials shall be power-tool cleaned in accordance with SSPC-SP 3 to remove mill scale, rust, grease, oil, and any other foreign matter. Welds shall be thoroughly wire brushed.
2. Exterior steel materials shall be blast cleaned in accordance with SSPC-SP 6/NACE No. 3 to remove visible mill scale, rust, grease, oil, and any other foreign matter. After cleaning and just before delivery of steel to the jobsite, steel materials shall be washed with solvent to remove dust and residue in accordance with SSPC-SP 1.

3. Primer to be shop applied shall be as recommended and approved by the manufacturer of the intumescent fireproofing material, and evidence of such approval shall be submitted to the Engineer for review.

PART 3 – EXECUTION

3.01 ERECTION AND INSTALLATION

- A. Reference Standards: Erection and installation of structural steel shall conform with the applicable requirements of AISC 303 and ANSI/AISC 360. Erection and installation of structural steel for railroad and transit rail bridges shall conform with applicable requirements of the AREMA Manual.
- B. Lines and Levels: Structural steel shall be installed accurately at established lines and levels. Steel shall be plumb and level before bolting is commenced. Installation shall be in accordance with accepted Shop Drawings and actual conditions, true and horizontal or perpendicular as the case may be, level and square, with angles and edges parallel with related lines of the building or structure.
- C. Temporary Bracing: Temporary bracing shall be provided as required and shall be kept in position until final completion. Shop fabricated items subject to damage shall be braced and carefully handled to prevent distortions or other damage. All items installed before concrete is placed shall be properly braced to prevent distortion by pressure of concrete. Bracing shall be watched and maintained by the Contractor during concreting operations.
- D. Anchors, Anchor Bolts, Studs, and Fasteners:
 1. Shop connections shall be welded and field connections bolted, unless indicated otherwise. Use washers under bolt heads and nuts to give full grip when nuts are turned tight. Use beveled washers where bolts bear on sloping surfaces.
 2. Anchors, bolts and washers, inserts, studs, and fasteners as required for the erection, installation, and completion of the work, and other miscellaneous steel or iron fastenings to be installed in forms before concrete placement, or built into concrete, shall be provided as indicated at the time scheduled for this work.
 3. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.
- E. Bases and Bearing Plates: Bases and plates which require grouting shall be supported at the correct level by means of adjustment nuts on anchor bolts. Bases and plates shall be set accurately using a high-strength, non-shrink grouting mortar as specified in Section 03 61 11, Non-Shrink Grout.
- F. Erection and Assembly:
 1. After erection and field assembly, the various members forming parts of the completed structure shall be aligned and adjusted accurately before being

fastened. Tolerances shall conform with the applicable requirements of AISC 303.

2. Fastening of splices of compression members shall be performed after the abutting surfaces have been brought into contact. Bearing surfaces and surfaces which will be in permanent contact shall be cleaned before the members are assembled. Splices will be permitted only where indicated.
 3. Unless removal is required, erection bolts used in welded construction may be tightened securely and left in place. If erection bolts are removed, the holes shall be filled with plug welds and ground smooth. Poor matching of holes shall be corrected by drilling to the next larger size and providing the next larger size bolt. Welding for redrilling will not be permitted.
 4. For moment-resisting joints with flanges or combined flange-reinforcing plates 1-1/2 inches thick or thicker, web bolts shall not be tightened past snug-tight until after completion of joint penetration welds.
- G. Driftpins: Driftpins may be used only to bring together the several parts or components. Fit-up bolts and driftpins shall not be used to bring out-of-tolerance fabricated members and components into alignment. Driftpins shall not be used with such force as to distort or damage the material.
- H. Gas Cutting: The use of a gas-cutting torch in the field for correcting fabrication errors will not be permitted.
- I. Bolting:
1. Bolts shall be driven accurately into holes without damaging the thread. Bolt heads shall be protected from damage during driving. Washers shall be placed under all bolt heads and nuts. Bolt heads and nuts shall rest squarely against the washers.
 2. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing to the head or nut. Bolt threads shall be upset or spoiled to prevent the nuts from backing off.
 3. Bolts transmitting shear shall be threaded to such a length that not more than one thread will be within the grip of the metal.
 4. Bolts shall extend through but not more than 1/4-inch beyond the nuts, unless otherwise indicated. Bolt heads and nuts shall be drawn tight against the work with a suitable wrench not less than 15 inches long. Bolt heads shall be tapped with a hammer while the nut is being tightened. After having been finally tightened, nuts shall be locked by upsetting or spoiling the threads as close as possible to the nut face and to a depth of penetration necessary to deform one or more threads on the bolt.
- J. High-Strength Bolting:

1. Assemble joints in accordance with AISC RCSC.
 2. Tighten bolts to their proof loads with calibrated impact wrenches to a torque not less than recommended for the size of the bolt.
 3. Assembly of joints using load-indicator washers shall conform to ASTM F959.
 4. Contact surfaces of joints shall be free of paint, lacquer, or other friction-reducing coatings.
- K. Sliding Joints: Properly clean sliding-joint assembly bearing surfaces and lubricate as required.

3.02 FIELD QUALITY CONTROL:

- A. Field-assembled and installed high-strength bolting shall be inspected and torque-tested in accordance with AISC RCSC by a qualified inspector selected and paid for by the Contractor. Submit the inspector's report of all high-strength bolted connections to the Engineer for review.

3.03 FIELD PAINTING

- A. After installation of structural steelwork, abraded areas, field bolts, and welds shall be touched up and spot painted with the same corrosion-inhibitive primer as was used for shop painting in accordance with SSPC-PA 1. Field welds shall be thoroughly wire-brushed or disc-sanded prior to touch-up painting.
- B. Steel to receive spray-applied fireproofing shall not be touch-up painted.
- C. Steel to receive intumescent fireproofing shall be touch-up painted in accordance with the requirements of the intumescent fireproofing manufacturer.
- D. Final field painting of exposed structural steel is specified in Section 09 91 00, Painting.

END OF SECTION 05 12 00