UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2014
****

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DIVISION 05 - METALS

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STRUCTURAL STEEL

11/11

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****
USACE / NAVFAC / AFCEC / NASA | UFGS-05 12 00 (November 2011)
Change 1 - 08/12

Preparing Activity: NAVFAC | Superseding
UFGS-05 12 00 (November 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 05 12 00

STRUCTURAL STEEL
11/11

****
NOTE: This guide specification covers requirements for structural steel used in building construction. The following publications should be reviewed for material selection and additional specification requirements before using this guide specification for the following types of construction:

Highway Bridges - American Association of State Highway and Transportation Officials (AASHTO)

Railroad Bridges - American Railway Engineering & Maintenance-of-Way Association (AREMA)

Tower Construction - Electronic Industries Alliance (EIA), RS-222-D, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

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 items(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).
****

****
NOTE: The following information shall be shown on the project drawings:

1. The extent and location of structural steel;

2. Designations of steel members;

3. Yield strength of steel used in design;

4. Locations where galvanized steel will be used;

5. Types of connections (welded and bolted), including adjustable runway support connections if overhead, top running cranes are provided;

6. Locations where high-strength bolts and slip critical connections are required and the loads and stresses required if design is provided by Contractor; and

7. The location of welds requiring nondestructive testing, along with the type of testing required.

****

PART 1 GENERAL

1.1 REFERENCES

****

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 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.

****

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201	(2006) AISC Certification Program for

Structural Steel Fabricators

AISC 303 (2010) Code of Standard Practice for Steel Buildings and Bridges

AISC 325 (2011) Steel Construction Manual

AISC 326 (2009) Detailing for Steel Construction

AISC 341 (2010) Seismic Provisions for Structural Steel Buildings

AISC 360 (2010) Specification for Structural Steel Buildings

AISC DESIGN GUIDE 10 (1997) Erection Bracing of Low-Rise Structural Steel Buildings

AISC DESIGN GUIDE 7 (2004) Industrial Buildings: Roofs to Anchor Rods

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man (2012) Manual for Railway Engineering

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1 (2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A108 (2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A123/A123M (2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A143/A143M (2007) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement

ASTM A153/A153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A193/A193M (2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting

	Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A242/A242M	(2013) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A276	(2013a) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	(2010; E 2013) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M	(2013) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A490	(2012) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A490M	(2012) Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A500/A500M	(2013) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A514/A514M	(2013) Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A529/A529M	(2005; R 2009) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)

ASTM A572/A572M	(2013a) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	(2010) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A6/A6M	(2013a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A618/A618M	(2004; R 2010) Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A668/A668M	(2013) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A709/A709M	(2013a) Standard Specification for Structural Steel for Bridges
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM B695	(2004; R 2009) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1107/C1107M	(2013) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827/C827M	(2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F1554	(2007a; E 2011) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F436	(2011) Hardened Steel Washers
ASTM F436M	(2011) Hardened Steel Washers (Metric)
ASTM F844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959	(2013) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F959M	(2013) Compressible-Washer-Type Direct

	Tension Indicators for Use with Structural Fasteners (Metric)

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70	(2010) Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC PS 13.01	(1982; E 2004) Epoxy Polyamide Painting System
SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.756	Steel Erection; Beams and Columns

1.2 SYSTEM DESCRIPTION

****
NOTE: The design should be checked to ensure that adequate supports at appropriate spacings have been provided for the installation of piping, expansion tanks, unit heaters, suspended ceilings and similar items.

Provisions for using self-locking nuts should be considered where shock or vibration would be a problem.
****

Provide the structural steel system, including [shop primer] [galvanizing], complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with [AISC 360 and AISC 341] except as modified in this contract.

1.3 SUBMITTALS

****
NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation 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

[Erection Plan, including description of temporary supports[; G][; G, [_____]]]

[Fabrication drawings including description of connections[; G][; G, [_____]]]

SD-03 Product Data

Shop primer

Welding electrodes and rods

Load indicator washers

Non-Shrink Grout

[Load indicator bolts]

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

[Galvanizing]

[Pins and rollers]

[AISC Quality Certification]

Overhead, top running crane rail beam

Welding procedures and qualifications

1.4 [AISC QUALITY CERTIFICATION

****
NOTE: AISC has a certification program in effect that confirms that a certified structural steel fabricating plant has the personnel, organization, experience, procedures, knowledge, equipment, capability, and commitment to produce fabricated steel of the required quality for a given category of structural steel framing. Consider deleting this paragraph if there is a minimal amount of steel on the job. Use Category "Std" for both Complex and Conventional Steel Structures (replaces Sbd and Cbd categories); use Category "Sbr" for Simple Steel Bridge Structures; ; use Category "Cbr" for Major Steel BridgesMBMA has a certification program in effect that confirms that a certified metal building manufacturer's fabrication plant has the quality management system ensuring continual compliance with requirements for Metal Building Systems.
****

Work shall be fabricated in an AISC certified Category [Std] [_____] fabrication plant.

]1.5 [SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with AISC 341.

]1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings shall not be reproductions of contract drawings. [Sign and seal fabrication drawings by a professional engineer registered in the State where the project is located.] Include complete information for the fabrication and erection of

the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Double connections that require an erection seat to comply with OSHA 29 CFR 1926.756(c)(1) shall be shown on the shop drawings, reviewed and approved by the structural engineer of record. Use AWS A2.4 standard welding symbols. [Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes[, with calculations,] as part of the drawings.] Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.6.2 Certifications

1.6.2.1 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance alignment requirements, areas out of tolerance and proposed corrective measures.

1.6.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing.

1.6.2.3 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. [If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.]

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

****
NOTE: Materials appropriate to the design will be selected and remaining materials will be deleted.

Designer should require materials, products, and innovative construction methods and techniques which are environmentally sensitive, take advantage of recycling and conserve natural resources.
****

****
NOTE: Designs requiring notch strength or installation and operation at low temperatures will require special material selections. Notch strength will be required based on design geometry or for dynamically loaded structures. When notch toughness is required, the supplementary requirements of the

ASTM specification for the steel being considered should be reviewed and the appropriate supplementary requirements (ASTM A6/A6M) specified. In designs where the material will be exposed to temperatures below freezing, the material type should be checked against the proposed ambient and working temperatures for resistance to brittle fracture.
****

2.1.1 Structural Steel

****
NOTE: ASTM A36/A36M is a general purpose structural grade steel with a minimum yield strength of 250 MPa 36 ksi. For notch toughness, a low-alloy steel should be considered. Increased corrosion resistance in non-marine environments can be obtained by specifying a minimum copper percentage of 0.2 percent. Check availability of shapes. Many are no longer American made.
****

ASTM A36/A36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

****
NOTE: ASTM A572/A572M steel is available in Grades 290 MPa 42 ksi, 345 MPa 50 ksi, 380 MPa 55 ksi, 415 MPa 60 ksi and 450 MPa 65 ksi of which only Grades 290 MPa 42 ksi and 345 MPa 50 ksi are used for dynamically loaded structures.

ASTM A992/A992M covers W shapes (rolled wide flange shapes) intended for use in building framing. For S, M, and HP shapes and channels, A36 or A572 Grade 50 should still be specified.

ASTM A709/A709M covers carbon and high-strength low-alloy steel structural shapes, plates, and bars and quenched and tempered alloy steel for structural plates intended for use in bridges. Seven grades are available in four yield strength levels as follows:

36 (250), 50 (345), 50S (345S), 50W (345W), HPS 50W (HPS 345W), HPS 70W (HPS 485W), HPS 100W (HPS 690W).

Grades 50W (345W), HPS 50W (HPS 345), HPS 70W (HPS 485W) and HPS 100W (HPS 690W) have enhanced atmospheric corrosion resistance.
****

ASTM A572/A572M [, Grade [_____]]. [ASTM A992/A992M [Grade [_____]]][ASTM A709/A709M [Grade [_____]]].

2.1.2.2 Quenched and Tempered Alloy Steel

****
NOTE: ASTM A514/A514M steel has a minimum yield strength of 690 MPa up to 65 mm thickness and 620 MPa for 65 mm to 150 mm thickness 90 to 100 ksi, depending on size, and is used for dynamically loaded structures and provides good notch toughness and abrasion resistance. ASTM A514/A514M covers 13 grades of steel, each with a different chemical composition and thickness. Unless a special chemical composition is desired, specifying a certain grade of ASTM A514/A514M steel is usually not required. Check availability of grades before specifying; normally only Grades A, F, H, and Q are stocked.
****

ASTM A514/A514M [, Grade [_____]].

2.1.3 Weathering Structural Steel

****
NOTE: Weathering steels provide atmospheric corrosion resistance of approximately four times that of carbon steel without copper (normal ASTM A36/A36M steel) in non-marine environments. ASTM A242/A242M steel has a minimum yield strength of 290 to 345 MPa 42 to 50 ksi (depending on size). ASTM A588/A588M steel has a minimum yield strength of 290 to 345 MPa 42 to 50 ksi (depending on size) and is available in four grades of steel, each with a different chemical composition. Unless a special chemical composition is desired, specifying a certain grade of ASTM A588/A588M steel is not required.
****

ASTM A242/A242M, Type 1; ASTM A588/A588M.

2.1.4 Structural Grade Carbon-Manganese Steel

****
NOTE: ASTM A529/A529M steel is routinely used for steel forging. This steel has a minimum number of inclusions. It has excellent welding properties, and may be used for the welded fabrications of special assemblies (for example, rocker bearings).
****

ASTM A529/A529M, high strength carbon-manganese steel of structural quality.

2.1.5 Structural Shapes for Use in Building Framing

****
NOTE: Whenever ASTM A992/A992M W-Shapes are required, their location must be clearly identified on the contract drawings.
****

Wide flange shapes, ASTM A992/A992M.

2.1.6 Structural Steel Tubing

****
NOTE: ASTM A500/A500M tubing is available in Grades A, B, C, and D with minimum yield strengths of 288, 290, 317, and 250 MPa 33, 42, 46, and 36 ksi for round structural tubing and 269, 317, 345, and 250 MPa 39, 46, 50, and 36 ksi for shaped structural tubing, respectively. ASTM A500/A500M tubing may not be suitable for dynamically loaded structures or applications requiring notch strength. ASTM A618/A618M is available in Grades I (a or b), II, or III. Grades I and II have a minimum yield strength of 315 to 345 MPa 46 to 50 ksi (depending on size); Grade III has a minimum yield strength of 345 MPa 50 ksi. ASTM A618/A618M, Grades Ia and Ib, have a corrosion resistance four times that of carbon steel in non-marine environments; Grade II has a corrosion resistance two times that of carbon steel in non-marine environments; and the corrosion resistance of Grade III can be increased by specifying a minimum copper percentage of 0.2 percent. For steel tubing, normally only ASTM A500/A500M, Grade B is stocked. ASTM A618/A618M tubing is available ASTM A325M ASTM A325 and ASTM A490M ASTM A490 only in round shapes.
****

ASTM A500/A500M, Grade [B] [_____]; ASTM A501; [ASTM A618/A618M, Grade [_____]].

2.1.7 Steel Pipe

****
NOTE: ASTM A53/A53M pipe, Type E (Electric-resistance Welded) and Type S (Seamless), Grade B, has a minimum yield strength of 245 MPa 35 ksi and is available in the following weight classes: STD (Standard), XS (Extra Strong), and XXS (Double-extra Strong).
****

ASTM A53/A53M, Type E or S, Grade B, weight class [STD (Standard)] [_____].

2.2 BOLTS, NUTS, AND WASHERS

****
NOTE: Commonly used bolts, nuts, and washers are listed under the applicable type of steel using the same terminology specified in "Steel" paragraph. Verify material selection with the designer and modify if required.
****

****
NOTE: Designs requiring notch strength or installation and operation at low temperatures will

require special material selections. Notch strength will be required based on design geometry or for dynamically loaded structures. When notch toughness is required, the supplementary requirements of the ASTM specification for the steel being considered should be reviewed and the appropriate supplementary requirements (ASTM A6/A6M) specified. In designs where the material will be exposed to temperatures below freezing, the material type should be checked against the proposed ambient and working temperatures for resistance to brittle fracture.

****

Provide the following unless indicated otherwise.

2.2.1 Structural Steel [, Steel Pipe]

2.2.1.1 Bolts

****

NOTE: Do not galvanize ASTM A490M ASTM A490 bolts. When galvanizing ASTM A325M ASTM A325 bolts limit hardness of bolts to Rockwell C-32.

****

****

NOTE: Do not mix bolt material specifications ASTM A325M and ASTM A490M ASTM A325 and ASTM A490 on the same diameter bolts in high strength connections. Do not place ASTM A325M and ASTM A490M ASTM A325 and ASTM A490 bolts, which have a hardness equal to or in excess of Rockwell C-32, in contact with a galvanized surface. The ASTM A325M and ASTM A490M ASTM A325 and ASTM A490 bolts specified are for a maximum diameter of M36 1.5 inch. If larger bolts are required, include the following ASTM publications in reference article:

ASTM A354 - Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

ASTM A449 - Quenched and Tempered Steel Bolts and Studs.

****

ASTM A307, Grade A; [ASTM A325M ASTM A325, Type 1], [ASTM A490M ASTM A490, Type 1]. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A563M, Grade A, heavy hex style, except nuts under M36 may be provided in hex style. ASTM A563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F844 washers for ASTM A307 bolts, and ASTM F436M ASTM F436 washers for

ASTM A325M ASTM A325 and ASTM A490M ASTM A490 bolts.

2.2.2 High-Strength Structural Steel [and Structural Steel Tubing]

2.2.2.1 Bolts

****
NOTE: Do not galvanize ASTM A490M ASTM A490 bolts. When galvanizing ASTM A325M ASTM A325 bolts limit hardness of bolts to Rockwell C-32.
****

****
NOTE: Do not mix bolt material specifications ASTM A325M and ASTM A490M ASTM A325 and ASTM A490 on the same diameter bolts in high strength connections. Do not place ASTM A325M and ASTM A490M ASTM A325 and ASTM A490 bolts, which have a hardness equal or in excess of Rockwell C-32, in contact with a galvanized surface. The ASTM A325M and ASTM A490M ASTM A325 and ASTM A490 bolts specified are for a maximum diameter of M36 1.5 inch. If larger bolts are required, include the following ASTM publications in reference article:

ASTM A354 - Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

ASTM A449 - Quenched and Tempered Steel Bolts and Studs.
****

ASTM A325M ASTM A325, Type 1 ASTM A490M ASTM A490, Type 1 or 2.

2.2.2.2 Nuts

ASTM A563M ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F436M ASTM F436, plain carbon steel.

2.2.3 Weathering Structural Steel

2.2.3.1 Bolts

ASTM A325M ASTM A325, Type 3; ASTM A490M ASTM A490, Type 3.

2.2.3.2 Nuts

ASTM A563M ASTM A563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A325M ASTM A325 bolts.

2.2.3.3 Washers

ASTM F436M ASTM F436, weathering steel.

2.2.4 Foundation Anchorage

****
NOTE: For most jobs, ASTM A1554 36 ksi anchor bolts are used. If high tensile loads are anticipated, the designer should consider the use of 55 ksi or 105 ksi ASTM A1554 anchor bolts. If stainless steel is considered, the designer should select from material in ASTM A193/A193M.
****

2.2.4.1 Anchor Bolts

ASTM F1554 Gr 36 [55] [105], Class 1A [2A]. [Stainless steel ASTM A193/A193M.]

2.2.4.2 Anchor Nuts

ASTM A563 ASTM A563, Grade A, hex style. [Stainless steel ASTM A193/A193M.]

2.2.4.3 Anchor Washers

ASTM F844. [Stainless steel [Type 304][Type 316] conforming to ASTM A276.]

2.2.4.4 Anchor Plate Washers

ASTM A36/A36M [Stainless steel [Type 304][Type 316] conforming to ASTM A276.]

2.2.5 Load Indicator Washers

****
NOTE: Include bracketed phrase if load indicator washers are to be galvanized.
****

ASTM F959M ASTM F959. [Provide ASTM B695, Class 50, Type 1 galvanizing.]

2.2.6 [Load Indicator Bolts

****
NOTE: Drawings or specifications should identify where these items are used.
****

ASTM A325M ASTM A325, Type 1; ASTM A490M ASTM A490, Type 1, with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

]2.2.7 [Self-Locking Nuts

****
NOTE: Drawings or specifications should identify where these items are used.
****

Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking

pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

]2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

****
NOTE: Some nonshrink grouts derive their nonshrink properties from an increase in volume of metal due to oxidation. Where oxidation is not desired for appearance sake, specify nonmetallic grout.
****

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. [Grout shall be nonmetallic.]

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.3.4 [Pins and Rollers

ASTM A668/A668M, Class C, D, F, or G; ASTM A108, Grades 1016 to 1030. Provide as specified in AASHTO HB-17, Division II, Sections 10.26 and 10.27, except provide pins in lengths to extend a minimum of 6 mm 0.25 inch beyond the outside faces of the connected parts.

]2.4 SHOP PRIMER

****
NOTE: Shop primer specified is for structural steel located inside a typical building. For buildings that will have a lot of structural steel exposed to view inside a building (i.e. hangars, maintenance shops), exterior structural steel, or other locations that will require a better shop primer, use of a zinc rich primer and epoxy coating system is recommended.
****

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 [GALVANIZING

****
NOTE: Most structural steel is painted. If galvanized items are required, they must be indicated or specified. The galvanizing specified is by the hot-dip process. This process requires large amounts of energy and unevenly heats steel

sections that are either large or thick, occasionally warping the steel sections. Using zinc coating by thermal spraying (metallizing) as an alternative to hot-dip galvanizing should be considered for certain steel sections. The following American Welding Society (AWS) publications should be consulted for further information:

TS-85 - Thermal Spraying - Practice, Theories, and Application

C2.2-67 - Recommended Practices for Metallizing with Aluminum and Zinc for Protection of Iron and Steel.

****

ASTM A123/A123M or ASTM A153/A153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

]2.6 [OVERHEAD, TOP RUNNING CRANE RAIL

****

NOTE: Crane rail shape and size shall be based on the crane capacity and maximum wheel loads. Consult the crane manufacturer for their recommended rail.

****

[AISC 325] [AREMA Eng Man], [_____] kg pound crane rail section and [bolted] [welded] joints. Provide rail fasteners and a minimum rail length of 3000 mm 10 feet.

]2.7 FABRICATION

2.7.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded [or on surfaces of weathering steels that will be exposed in the completed structure]. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. [Affix embossed tags to hot-dipped galvanized members.]

2.7.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, [surfaces to receive sprayed-on fireproofing,] [surfaces to receive epoxy coatings,] [surfaces designed as part of a composite steel concrete section,] or surfaces within 13 mm 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 7 degrees C or over 35 degrees C 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 4 degrees C 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.7.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.7.2.2 Primer

Apply primer to a minimum dry film thickness of 0.05 mm 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.7.3 [[Fireproofing] [and] [Epoxy] Coated Surfaces

Surfaces to receive [sprayed-on fireproofing] [epoxy] coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section 07 81 00 SPRAY-APPLIED FIREPROOFING.

]2.7.4 [Surface Finishes

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NOTE: AISC states "finished" surfaces, where identified, should have a maximum roughness of 500. For pins and bearing surfaces, a maximum roughness of 125, in lieu of 500, is recommended.
****

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

]2.8 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 13 mm 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

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NOTE: If bearing-type high strength bolted connections are required, delete the painting exception for contact surfaces of friction-type high-strength bolted connections.

AISC fabrication plant certification is required for the structural steel to be furnished for the project. The requirement for AISC fabrication plant certification may be deleted at the discretion of the designer. This decision will be based on the complexity of the design and the criticality of the connections. If moment connections are involved, AISC certification is recommended. The quantity of

structural steel in the project should be a point of consideration. The certification categories, as defined in AISC 201, are:

a. Conventional Steel Building Structures

b. Simple Steel Bridge Structures

c. Complex Steel Building Structures

d. Major Steel Bridges

e. Metal Building Systems

f. Supplement: Auxiliary and Support Structures for Nuclear Power Plants - This supplement, applicable to nuclear plant structures designed under the AISC Specification, but not to pressure-retaining structures, offers utility companies and designers of nuclear power plants a certification program that will eliminate the need for many of the more costly, conflicting programs now in use.

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Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC 201 for Category [_____] [Supplement] structural steelwork.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A6/A6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with [endorsement "P" of AISC 201] [_____] and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

3.2 INSTALLATION

3.2.1 [Overhead, Top Running Cranes

Runway rails and beams shall be provided in accordance with [AISC DESIGN GUIDE 7] and CMAA 70, except that in case of conflict, the requirements of CMAA 70 shall govern. Crane rail splices shall be bolted or welded. In addition, provide a maximum vertical difference of 0.8 mm 0.03 inch in the elevation between adjacent runway rail tops and adjacent runway beam tops at joints, a maximum horizontal rail separation at joints not to exceed 1.6mm 0.0625 inch. Vertical and horizontal alignment at joints should be maintained as closely as possible. Rail joints shall be ground flush as necessary to provide a smooth transition from each rail segment to the next. Provide adjustable runway support connections to

allow placement of the crane rails and beams to the tolerances specified. Rail joints on opposite sides of the runway shall be staggered. Stagger rail joints a minimum of one foot, except that the stagger shall not be the same as the crane wheel spacing.

]3.3 ERECTION

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NOTE: For low-rise structural steel buildings, the designer must design the structure to be erected in accordance with AISC DESIGN GUIDE 10.
****

a. Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of [AISC 325] [endorsement F of AISC 201]. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

b. For low-rise structural steel buildings (18 m 60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance with AISC DESIGN GUIDE 10.

c. Do not splice truss top and bottom chords except as approved by the Contracting Officer. Chord splices shall occur at panel joints at approximately the third point of the span. The center of gravity lines of truss members shall intersect at panel points unless otherwise approved by the Contracting Officer. When the center of gravity lines do not intersect at a panel point, provisions shall be made for the stresses due to eccentricity. Cumber of trusses shall be 3 mm 1/8 inch in 10 feet unless otherwise indicated.

****
NOTE: Good design practice provides most connections and members with proper drainage. If ponding of water cannot be avoided, specify a waterproofing material to suit the job's specific needs.
****

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.4 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt [and pin] holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.4.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.4.2 High-Strength Bolts

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NOTE: The four bolt tightening methods currently allowed by AISC will provide acceptable results if bolt assemblies are kept free of dirt and rust, if properly lubricated, and if proper installation procedures are followed. Because these conditions are rarely encountered during normal construction, use only direct tension indicator tightening methods where slip critical connections are required.
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NOTE: Include bracketed item for all jobs and delete the first sentence of the paragraph. Slip critical connections must be identified on the drawings.
****

ASTM A325M ASTM A325 and ASTM A490M ASTM A490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. [Provide load indicator bolts or washers in all [ASTM A325M ASTM A325M] [or] [ASTM A490M ASTM A490] bolted connections, except provide only load indicator washers for slip critical connections. Direct tension indicator tightening, [, or installation of alternate design fasteners,] shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections.] Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.4.2.1 Installation of Load Indicator Washers (LIW)

ASTM F959M ASTM F959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F436M ASTM F436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F436M ASTM F436 washers under both the bolt head and nut when ASTM A490M ASTM A490 bolts are used.

3.5 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.6 WELDING

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NOTE: Section 05 05 23.13 10 ULTRASONIC INSPECTION OF WELDMENTS must be used for all buildings in Seismic Design Categories D, E and F and buildings in category C when designed in accordance with the 2005 AISC Seismic Provisions for Structural Steel Buildings.
****

AWS D1.1/D1.1M[, except use only shielded metal arc welding and low hydrogen electrodes for ASTM A514/A514M steel. Do not stress relieve ASTM A514/A514M steel by heat treatment]. [Grind exposed welds smooth as indicated.] Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.6.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

[Removal is not required] [Remove only from finished areas].

3.7 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.7.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.8 [GALVANIZING REPAIR

****
NOTE: Most structural steel is painted. If galvanized items are required, they must be indicated or specified. The galvanizing specified is by the hot-dip process. This process requires large amounts of energy and unevenly heats steel sections that are either large or thick, occasionally warping the steel sections. Using zinc coating by thermal spraying (metallizing) as an alternative to hot-dip galvanizing should be considered for certain steel sections. The following American Welding Society (AWS) publications should be consulted for further information:

TS-85 - Thermal Spraying - Practice, Theories, and

Application

C2.2-67 - Recommended Practices for Metallizing with Aluminum and Zinc for Protection of Iron and Steel.

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Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

]3.9 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing[, except that electric power for field tests will be furnished as set forth in Division 1]. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.9.1 Welds

3.9.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

[Inspection by the Government will include proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use.]

[The Contractor shall inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use.]

3.9.1.2 Nondestructive Testing

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NOTE: The designer shall indicate the location of test welds and types of testing desired. The following information is presented as guidance. Dye penetrant testing detects small surface defects by enhancing the visibility of the flaw. Magnetic particle testing detects surface cracks and near-surface cracks; this test provides more information than the dye penetrant testing, and for approximately the same cost. Ultrasonic and radiographic testing detect surface and internal cracks, delaminations, lack of fusion, and density and thickness variations; these tests offer basically the same information, but their usage is limited by location and type of weld. Generally, fillet welds can only be dye penetrant or magnetic particle tested. Complete penetration welds at butt joints should be radiographically tested; all other complete penetration welds should be ultrasonically

tested.

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AWS D1.1/D1.1M. Test locations shall be [as indicated] [selected by the Contracting Officer]. If more than [20] [_____] percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Radiographic	[_____]
Ultrasonic	[_____]
Magnetic Particle	[_____]
Dye Penetrant	[_____]

3.9.2 Load Indicator Washers

3.9.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.38 mm 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.13 mm 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F959M ASTM F959.

3.9.2.2 [Load Indicator Gaps

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NOTE: Use this paragraph on large complex structural steel systems or on jobs where minimal on site inspection is expected.

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In addition to the above testing, an independent testing agency as approved by the Contracting Officer, shall test in place the load indicator gapson 20 percent of the installed load indicator washers to verify that the ASTM F959M ASTM F959 load indicator gaps have been achieved. If more than 10 percent of the load indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F959M ASTM F959, then all in place load indicator washers shall be tested to verify that the ASTM F959M ASTM F959 load indicator gaps have been achieved. Test locations shall be selected by the Contracting Officer.

]3.9.3 [Overhead, Top Running Crane Rails and Beams

Runway rails and beams shall be surveyed (horizontally and vertically) after installation to verify compliance with the tolerance requirements of AISC DESIGN GUIDE 7, CMAA 70, and the additional alignment tolerance

requirements specified in this section. After each survey, submit a written report to the Contracting Officer with the following information: field alignment survey results, tolerance requirements, areas out of tolerance, and proposed corrective measures. Proposed corrective measures shall be approved by the Contracting Officer. Following completion of corrective measures, areas that were previously out of tolerance shall be re-surveyed and another written report shall be furnished to the Contracting Officer. Field surveys shall be performed and sealed by a registered land surveyor.

]3.9.4 High-Strength Bolts

3.9.4.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of [3] [_____] bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in [AISC 360], depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.9.4.2 Inspection

Inspection procedures shall be in accordance with [AISC 360] . Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

[Inspection by the Government will include calibration of torque wrenches for high-strength bolts.][The Contractor shall inspect calibration of torque wrenches for high-strength bolts.]3.9.4.3 Testing

The Government has the option to perform nondestructive tests on [5] [_____] percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The Contractor shall allow access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than [10] [_____] percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

3.9.5 [Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication.

]3.10 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

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NOTE: This paragraph will be applicable to both new buildings and existing building seismic rehabilitation designs done according to UFC 3-310-04, "Seismic Design for Buildings".

The designer must indicate on the drawings all locations and all features for which special inspection and testing is required. This includes indicating the locations of all structural components and connections requiring inspections.

Add any additional requirements as necessary

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Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --