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USACE / NAVFAC / AFCESA **UFGS-05120 (August 2003)**

Preparing Activity: NAVFAC **Superseding UFGS-05120N (July 2002)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags
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DIVISION 05 - METALS

SECTION 05120

STRUCTURAL STEEL

08/03

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SECTION 05120

STRUCTURAL STEEL
08/03

****
NOTE: This guide specification covers the requirements for structural steel used in building construction.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
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****
NOTE: 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."
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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

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NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

****

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) Standard Specifications for Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2000) Code of Standard Practice for Steel Buildings and Bridges
AISC 316	(1989) ASD Manual of Steel Construction
AISC 317	(1992) ASD Manual of Steel Construction, Vol II: Connections
AISC 325	(2001) LRFD Manual of Steel Construction
AISC 326	(2002) Detailing for Steel Construction

AISC 335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design
AISC 341	(2002) Seismic Provisions for Structural Steel Buildings
AISC 348	(2000) Structural Joints Using ASTM A325 or A490 Bolts
AISC 350	(1999) Load and Resistance Factor Design (LRFD)Specification for Structural Steel Buildings
AISC 810	(1997) Design Guide 10: Erection Bracing of Low-Rise Structural Steel Frames/Fisher and West
AISC FCD	(1995a) AISC Quality Certification Program
AISC M018L	(1999) LRFD Manual of Steel Construction, Metric Conversion Volume I
AISC M019L	(1999) LRFD Manual of Steel Construction, Metric Conversion Volume II
AISC S340	(1992) Metric Properties of Structural Shapes with Dimensions According to ASTM A6M

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

AREMA Manual	(2003) Manual for Railway Engineering

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(1995) Surface Texture, (Surface Roughness, Waviness and Lay)

ASTM INTERNATIONAL (ASTM)

ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 143	(2003) Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement

ASTM A 153/A 153M	(2003) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 242/A 242M	(2003a) High-Strength Low-Alloy Structural Steel
ASTM A 307	(2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2002) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2003) Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2003a) Carbon Structural Steel
ASTM A 490	(2002) Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2003) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(2003) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2001) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(2000a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(2003) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2000) Carbon and Alloy Steel Nuts
ASTM A 563M	(2001) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(2003a) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2003) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 6/A 6M	(2003a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM A 618	(2001) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 668/A 668M	(2003) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 709/A 709M	(2003a) Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 852/A 852M	(2003) Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM A 992/A 992M	(2002) Steel for Structural Shapes for Use in Building Framing
ASTM B 695	(2000) Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM C 827	(2001a) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F 436	(2003) Hardened Steel Washers
ASTM F 436M	(2003) Hardened Steel Washers (Metric)
ASTM F 844	(2000) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(2002) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F 959M	(2002) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70	(2000) Top Running and Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1982; R 2000) Epoxy-Polyamide Painting

	System
SSPC Paint 25	(1997; R 2000) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 3	(1982; R 2000) Power Tool Cleaning
SSPC SP 6	(2000) Commercial Blast Cleaning

1.2 SYSTEM DESCRIPTION

****
NOTE: Consult with the structural designer. Use AISC 316 and AISC 317 when allowable stress is used for design, and use the AISC 325 when the load and resistance factor is used for design. Most designers are using AISC 316 and AISC 317.
****

****
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 316 and AISC 317] [AISC 325] except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

****
NOTE: Use the first paragraph when AISC 316 and AISC 317 (allowable stress) is used for design, and use the second paragraph when AISC 325 (load and resistance factor) is used for design.
****

[In [AISC 316, AISC 317, AISC 335, AISC 303, AISC 348, and AISC S340, except as modified in this section, shall be considered a part of AISC 316 and AISC 317 and is referred to in this section as AISC 316 and AISC 317.]]

[In [AISC 325, AISC 350, AISC 303, AISC 348, and AISC S340, except as modified in this section, shall be considered a part of AISC M018L and AISC M019L and is referred to in this section as AISC 325.]]

1.4 SUBMITTALS

****
NOTE: Submittals must be limited to those necessary

for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" 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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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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.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

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

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

SD-03 Product Data

Shop primer

Load indicator washers

[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

Shop primer

Welding electrodes and rods

Nonshrink grout

[Galvanizing]

[Pins and rollers]

[AISC Quality Certification]

Overhead, top running crane rail beam

Welding procedures and qualifications

[1.5 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 "Sbd" for Conventional Steel Structures, (replaces Category I); use Category "Sbr" for Simple Steel Bridge Structures, (replaces Category I); use Category "Cbd" for Complex Steel Building Structures, (replaces Category II); use Category "Cbr" for Major Steel Bridges, (replaces Category III); and use Category "MB" for Metal Building Systems.
****

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

][1.6 SEISMIC PROVISIONS

****
NOTE: When using AISC 325 (load and resistance

factor) for design, and the project is in Seismic Zone 2 or greater, include the following paragraph.
****

In addition to AISC 325, the structural steel system shall be provided in accordance with AISC 341.

]1.7 QUALITY ASSURANCE

1.7.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 316 and AISC 317. Drawings shall not be reproductions of contract drawings. 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. 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.]

1.7.2 Certifications

1.7.2.1 Overhead, Top Running Crane Rail Beam

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

1.7.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.7.2.3 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.

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 A 6) 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 A 36/A 36M 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 A 36/A 36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

****
NOTE: ASTM A 572/A 572M steel is available in Grades 345 MPa (number representing yield strength in ksi) 42, 50, 60, and 65, of which only Grades 42 and 50 are used for dynamically loaded structures.

ASTM A 992 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 A 709/A 709M 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. Eight 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], 100 [690], 100W [690W].

Grades 50W [345W], HPS 50W [HPS 345], HPS 70W [HPS 485W], and 100W [690W] have enhanced atmospheric

corrosion resistance.

****

ASTM A 572/A 572M [, Grade [_____]]. [ASTM A 992/A 992M [Grade [_____]]][ASTM A 709/A 709M [Grade [_____]]].

2.1.2.2 Quenched and Tempered Alloy Steel

****

NOTE: ASTM A 514 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 A 514 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 A 514 steel is usually not required. Check availability of grades before specifying; normally only Grades A, F, H, and Q are stocked.

****

ASTM A 514/A 514M [, Grade [_____]].

2.1.2.3 Quenched and Tempered Low-Alloy Steel

****

NOTE: Check the availability of ASTM A 852. It has been found that in some cases it is not available in small quantities.

****

ASTM A 852/A 852M, 70 ksi.

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 A 36/A 36M steel) in non-marine environments. ASTM A 242 steel has a minimum yield strength of 290 to 345 MPa 42 to 50 ksi (depending on size). ASTM A 588 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 A 588 steel is not required.

****

ASTM A 242/A 242M, Type 1; ASTM A 588/A 588M.

2.1.4 Structural Grade Carbon-Manganese Steel

****

NOTE: ASTM A 529/A 529M 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 A 529/A 529M, high strength carbon-manganese steel of structural quality.

2.1.5 Structural Shapes for Use in Building Framing

****

NOTE: Whenever ASTM A 992 W-Shapes are required, their location must be clearly identified on the contract drawings.

****

Wide flange shapes, ASTM A 992/A 992M.

2.1.6 Structural Steel Tubing

****

NOTE: ASTM A 500 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 A 500 tubing may not be suitable for dynamically loaded structures or applications requiring notch strength. ASTM A 618 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 A 618, 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 A 500, Grade B is stocked. ASTM A 618 tubing is available ASTM A 325M ASTM A 325 and ASTM A 490M ASTM A 490 only in round shapes.

****

ASTM A 500, Grade [B] [_____]; ASTM A 501; [ASTM A 618, Grade [_____]].

2.1.7 Steel Pipe

****

NOTE: ASTM A 53 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 A 53, 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 A 6) 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 A 490 bolts. When galvanizing ASTM A 325 bolts limit hardness of bolts to Rockwell C-32.
****

****
NOTE: Do not mix bolt material specifications ASTM A 325M and ASTM A 490M ASTM A 325 and ASTM A 490 on the same diameter bolts in high strength connections. Do not place ASTM A 325M and ASTM A 490M ASTM A 325 and ASTM A 490 bolts, which have a hardness equal to or in excess of Rockwell C-32, in contact with a galvanized surface. The ASTM A 325M and ASTM A 490M ASTM A 325 and ASTM A 490 bolts specified are for a maximum diameter of M36 1.5 inches. If larger bolts are required, include the following ASTM publications in reference article:

ASTM A 354 - Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

ASTM A 449 - Quenched and Tempered Steel Bolts and Studs.
****

ASTM A 307, Grade A; [ASTM A 325M ASTM A 325, Type 1], [ASTM A 490M ASTM A 490, 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 A 563M, Grade A , heavy hex style, except nuts under M36 may be provided in hex style. ASTM A 563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436M ASTM F 436 washers for ASTM A 325M ASTM A 325 and ASTM A 490M ASTM A 490 bolts.

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

2.2.2.1 Bolts

****

NOTE: Do not galvanize ASTM A 490 bolts. When galvanizing ASTM A 325 bolts limit hardness of bolts to Rockwell C-32.

****

****

NOTE: Do not mix bolt material specifications ASTM A 325M and ASTM A 490M ASTM A 325 and ASTM A 490 on the same diameter bolts in high strength connections. Do not place ASTM A 325M and ASTM A 490M ASTM A 325 and ASTM A 490 bolts, which have a hardness equal or in excess of Rockwell C-32, in contact with a galvanized surface. The ASTM A 325M and ASTM A 490M ASTM A 325 and ASTM A 490 bolts specified are for a maximum diameter of M36 1.5 inches. If larger bolts are required, include the following ASTM publications in reference article:

ASTM A 354 - Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

ASTM A 449 - Quenched and Tempered Steel Bolts and Studs.

****

ASTM A 325M ASTM A 325, Type 1 ASTM A 490M ASTM A 490, Type 1 or 2.

2.2.2.2 Nuts

ASTM A 563M ASTM A 563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F 436M ASTM F 436, plain carbon steel.

2.2.3 Weathering Structural Steel

2.2.3.1 Bolts

ASTM A 325M ASTM A 325, Type 3; ASTM A 490M ASTM A 490, Type 3.

2.2.3.2 Nuts

ASTM A 563M ASTM A 563, heavy hex style, Grade DH3, except Grade C3 may be furnished forn ASTM A 325M ASTM A 325bolts.

2.2.3.3 Washers

ASTM F 436M ASTM F 436, weathering steel.

2.2.4 Foundation Anchorage

****
NOTE: For most jobs, ASTM A 307 anchor bolts are used. If high tensile loads are anticipated, the designer should consider the use of ASTM A 449 anchor bolts.
****

2.2.4.1 Bolts

ASTM A 307.

2.2.4.2 Nuts

ASTM A 563 ASTM A 563, Grade A, hex style.

2.2.4.3 Washers

ASTM F 844.

2.2.5 Load Indicator Washers

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

ASTM F 959M ASTM F 959. [Provide ASTM B 695, Class 50, Type 1 galvanizing.]

[2.2.6 Load Indicator Bolts

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

ASTM A 325M ASTM A 325, Type 1; ASTM A 490M ASTM A 490, 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 Nonshrink 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 C 1107, with no ASTM C 827 shrinkage. [Grout shall be nonmetallic.]

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

[2.3.4 Pins and Rollers

ASTM A 668/A 668M, Class C, D, F, or G; ASTM A 108, 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 316 and AISC 317 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 A 123/A 123M or ASTM A 153/A 153M, 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 316 and AISC 317] [AISC 325] [AREMA Manual], [_____] 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, 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

****

NOTE: Insert appropriate Section number and title in blank below and format using UFC 1-300-02.

****

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 [07810 SPRAY-APPLIED FIREPROOFING] [_____], ["_____"].

][2.7.4 Surface Finishes

****

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.

]PART 3 EXECUTION

3.1 FABRICATION

****

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 FCD, 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.

****

Fabrication shall be in accordance with the applicable provisions of AISC 316. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category [_____] [Supplement] structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. 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 FCD] [_____] and primed with the specified paint.

3.2 INSTALLATION

[3.2.1 Overhead, Top Running Cranes

****

NOTE: Consult with the structural designer. Use AISC 316 and AISC 317 when allowable stress is used for design, and use the AISC 325 when the load and resistance factor is used for design. Most designers are using AISC 316 and AISC 317.

****

Runway rails and beams shall be provided in accordance with [AISC 316and AISC 317] [AISC 325] and CMAA 70, except that in case of conflict, the

requirements of CMAA 70 shall govern. 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. Provide adjustable runway support connections to allow placement of the crane rails and beams to the tolerances specified. Stagger runway rail joints a minimum of one foot, except that the stagger shall not be the same as the crane wheel spacing.

]3.3 ERECTION

****
NOTE: For low-rise structural steel buildings, the designer must design the structure to be erected in accordance with AISC 810.
****

a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of [AISC 316] [AISC 325] [endorsement F of AISC FCD]. 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 withAISC 810.

****
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

****
NOTE: Use AISC 335 for designs using AISC 316 and AISC 317 (allowable stress), and use AISC 350 for designs using AISC 325 (load and resistance factor).
****

Except as modified in this section, connections not detailed shall be designed in accordance with [AISC 335] [AISC 350]. 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. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.4.1 Common Grade Bolts

ASTM A 307 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

****
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.
****

****
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 A 325M ASTM A 325 and ASTM A 490M ASTM A 490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. [Provide load indicator bolts or washers in all [ASTM A 325M ASTM A 325M] [or] [ASTM A 490M ASTM A 490] 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 F 959M ASTM F 959. 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 F 436M ASTM F 436 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 F 436M ASTM F 436 washers under both the bolt head and nut when ASTM A 490M ASTM A 490 bolts are used.

3.5 WELDING

****
NOTE: For jobs in Iceland, in lieu of AWS welders and inspectors, use "Technological Institute of Iceland" certified welders and inspectors.
****
****

NOTE: Section 05090 WELDING, STRUCTURAL 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 1997 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 A 514/A 514M steel. Do not stress relieve ASTM A 514/A 514M 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.

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

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

3.6 SHOP PRIMER REPAIR

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

3.6.1 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.

[3.7 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.

****

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

]3.8 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.

3.8.1 Welds

3.8.1.1 Visual Inspection

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NOTE: For jobs in Iceland, in lieu of AWS welders and inspectors, use "Technological Institute of Iceland" certified welders and inspectors.

****

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.

3.8.1.2 Nondestructive Testing

****

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.

****

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.

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

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

3.8.2 Load Indicator Washers

3.8.2.1 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 F 959M ASTM F 959.

[3.8.2.2 Load Indicator Gaps

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

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 F 959M ASTM F 959 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 F 959M ASTM F 959, then all in place load indicator washers shall be tested to verify that the ASTM F 959M ASTM F 959 load indicator gaps have been achieved. Test locations shall be selected by the Contracting Officer.

][3.8.3 Overhead, Top Running Crane Rails and Beams

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NOTE: Include paragraph for overhead, top running cranes. Underhung bridge cranes and monorail systems are normally provided with their own patented track systems and do not normally require the tight tolerances specified for overhead, top running cranes.
****

Runway rails and beams shall be surveyed (horizontally and vertically) after installation to verify compliance with the tolerance requirements of

CMAA 70 and the additional tolerance requirements specified in this section. After each survey, submit a written report to the Contracting Officer with the following information: field 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.

]3.8.4 High-Strength Bolts

3.8.4.1 Testing Bolt, Nut, and Washer Assemblies

****
NOTE: Use AISC 348 for designs using AISC 316 and AISC 317 (allowable stress), and use AISC 348 for designs using AISC 325 (load and resistance factor).
****

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 348] [AISC 348], Table 4, 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.

3.8.4.2 Inspection

****
NOTE: Use AISC 348 for designs using AISC 316 and AISC 317 (allowable stress), and use AISC 348 for designs using AISC 325 (load and resistance factor).
****

Inspection procedures shall be in accordance with [AISC 348] [AISC 348], Section 9. 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.

3.8.4.3 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 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. Retest new bolts after installation.

[3.8.5 Testing for Embrittlement

ASTM A 143 for steel products hot-dip galvanized after fabrication.

]3.9 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

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NOTE: Include this paragraph only when special inspection and testing for seismic-resisting systems is required by paragraph 3.2 of FEMA 302, NEHRP RECOMMENDED PROVISIONS FOR SEISMIC REGULATIONS FOR NEW BUILDINGS AND OTHER STRUCTURES.

This paragraph will be applicable to both new buildings designed according to TI 809-04, SEISMIC DESIGN FOR BUIDLINGS, and the existing building seismic rehabilitation designs done according to TI 809-05, SEISMIC EVALUATION AND REHABILITATION FOR BUILDINGS.

The designer must indicate on the drawings all locations and all features for which special inspection and testing is required in accordance with Chapter 3 of FEMA 302. This includes indicating the locations of all structural components and connections requiring inspections.

Add any additional requirements as necessary
****

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --