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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 18 July 2006

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DIVISION 05 - METALS

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NOTE: This guide specification covers the requirements for providing all equipment, materials, and labor for fabricating, furnishing, and installing miscellaneous metal materials, standard metal articles, and shop fabricated items for Civil Works type structures.

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.

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.

ALUMINUM ASSOCIATION (AA)

AA 46 (1978) Standards for Anodized Architectural Aluminum

AA DAF-45 (2003) Designation System for Aluminum Finishes

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17 (2002; Errata 2003) Standard Specifications for Highway Bridges

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2006) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B16.3 (1998) Malleable Iron Threaded Fittings

ASME B16.5 (2003) Pipe Flanges and Flanged Fittings

ASME B16.9 (2003) Factory-Made Wrought Steel Buttwelding Fittings

ASME B18.2.1 (1996; R 2005) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (1987; R 2005) Square and Hex Nuts

ASME B18.21.1 (1999; R 2005) Lock Washers (Inch Series)

ASME B18.22.1 (1965; R 2003) Plain Washers

ASME B18.22M (1981; R 2000) Metric Plain Washers

ASME B18.3 (1998) Socket Cap Shoulder and Set Screws, Hex and Spline Keys (Inch Series)

ASME B18.6.1 (1981; R 1997) Wood Screws (Inch Series)

ASME B18.6.2 (1998) Slotted Head Cap Screws, Square

Head Set Screws, and Slotted Headless Set Screws: Inch Series (B18.6.2)

ASME B18.6.3 (2003) Machine Screws and Machine Screw Nuts

ASME B27.7 (1977; R 1999) General Purpose Tapered and Reduced Cross Section Retaining Rings

ASTM INTERNATIONAL (ASTM)

ASTM A 1 (2005) Carbon Steel Tee Rails

ASTM A 109/A 109M (2003) Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled

ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 148/A 148M (2003) Steel Castings, High Strength, for Structural Purposes

ASTM A 153/A 153M (2005) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 193/A 193M (2005) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 194/A 194M (2005) Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both

ASTM A 20/A 20M (2004a) General Requirements for Steel Plates for Pressure Vessels

ASTM A 240/A 240M (2004ae1) Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications

ASTM A 263 (2003) Stainless Chromium Steel-Clad Plate

ASTM A 264 (2003) Stainless Chromium-Nickel Steel-Clad Plate

ASTM A 27/A 27M (2005) Steel Castings, Carbon, for General Application

ASTM A 276 (2005) Stainless Steel Bars and Shapes

ASTM A 307 (2004) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 312/A 312M (2005) Seamless and Welded Austenitic Stainless Steel Pipes

ASTM A 320/A 320M (2004) Alloy/Steel Bolting Materials for Low-Temperature Service

ASTM A 325	(2004b) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2004b) Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2005) Carbon Structural Steel
ASTM A 467/A 467M	(2001) Machine and Coil Chain
ASTM A 475	(2003) Zinc-Coated Steel Wire Strand
ASTM A 484/A 484M	(2003a) General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A 490	(2004a) Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2004a) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(2003a) 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 504/A 504M	(2004e1) Wrought Carbon Steel Wheels
ASTM A 514/A 514M	(2000a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 516/A 516M	(2004) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 519	(2003) Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 564/A 564M	(2004) Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A 572/A 572M	(2004) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2005) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick

ASTM A 618	(2004) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 653/A 653M	(2004a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 668/A 668M	(2004) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 730	(1993; R 1999) Forgings, Carbon and Alloy Steel, for Railway Use
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 786/A 786M	(2000b) Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A 924/A 924M	(2004) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 121/B 121M	(2001) Lead Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B 124/B 124M	(2004) Copper and Copper Alloy Forging Rod, Bar, and Shapes
ASTM B 138/B 138M	(2001) Manganese Bronze Rod, Bar and Shapes
ASTM B 148	(1997; R 2003e1) Aluminum-Bronze Sand Castings
ASTM B 150/B 150M	(2003) Aluminum Bronze Rod, Bar, and Shapes
ASTM B 152/B 152M	(2000) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 176	(2004) Copper-Alloy Die Castings
ASTM B 209	(2004) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2004) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 21/B 21M	(2001e1) Naval Brass Rod, Bar, and Shapes
ASTM B 211	(2003) Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(2003) Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 221	(2005) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and

Tubes

ASTM B 23	(2000) White Metal Bearing Alloys (known Commercially as "Babbitt Metal")
ASTM B 241/B 241M	(2002) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 26/B 26M	(2005) Aluminum-Alloy Sand Castings
ASTM B 271	(1996; R 2003) Copper-Base Alloy Centrifugal Castings
ASTM B 308/B 308M	(2002) Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B 36/B 36M	(2001) Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B 429	(2002) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B 505/B 505M	(2004) Copper-Base Alloy Continuous Castings
ASTM B 584	(2004) Copper Alloy Sand Castings for General Applications
ASTM B 6	(2003) Zinc
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 749	(2003) Lead and Lead Alloy Strip, Sheet, and Plate Products
ASTM B 763	(2004) Copper Alloy Sand Castings for Valve Application
ASTM B 806	(2004) Copper Alloy Permanent Mold Castings for General Applications
ASTM B 824	(2004) General Requirements for Copper Alloy Castings
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM F 436	(2004) Hardened Steel Washers
ASTM F 436M	(2004) Hardened Steel Washers (Metric)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2000) Metal Bar Grating Manual
NAAMM MBG 531S	(1989) Guide Specification for Stainless Steel Grating

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25 (1997; R 2004) Zinc Oxide, Alkyd, Linseed
Oil Primer for Use Over Hand Cleaned
Steel, Type I and Type II

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2003) Safety -- Safety and Health
Requirements

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922 (Rev A; Notice 1) Shield, Expansion
(Caulking Anchors, Single Lead)

CID A-A-1923 (Rev A; Notice 1) Shield, Expansion (Lag,
Machine and Externally Threaded Wedge Bolt
Anchors)

CID A-A-1924 (Rev A; Notice 1) Shield, Expansion (Self
Drilling Tubular Expansion Shell Bolt
Anchors)

CID A-A-1925 (Rev A; Notice 1) Shield Expansion (Nail
Anchors)

CID A-A-55614 (Basic; Notice 1) Shield, Expansion
(Non-Drilling Expansion Anchors)

CID A-A-55615 (Basic; Notice 1) Shield, Expansion (Wood
Screw and Lag Bolt Self-Threading Anchors)

CID A-A-60005 (Basic; Notice 1) Frames, Covers,
Gratings, Steps, Sump And Catch Basin,
Manhole

FS RR-C-271 (Rev D; Am 1) Chains and Attachments,
Welded and Weldless

FS RR-W-410 (Rev E) Wire Rope and Strand

1.2 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. Submittals should be kept
to the minimum required for adequate quality control.

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, 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.] [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 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Miscellaneous Metals and Standard Metal Articles[; G][; G, [____]]
Shop Fabricated Metal Items[; G][; G, [____]]

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catablog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: [____]

SD-03 Product Data

Miscellaneous Metals and Standard Metal Articles[; G][; G, [____]]
Shop Fabricated Metal Items[; G][; G, [____]]

Lists of materials, and records which identify the disposition of approved material and fabricated items in the work, shall be submitted for approval as specified and in Section 05 50 03.00 10 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-04 Samples

Miscellaneous Metals and Standard Metal Articles[; G][; G, [____]]
Shop Fabricated Metal Items[; G][; G, [____]]

Samples of the following items: [____]. Samples of standard or fabricated items shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, and may be installed in the work, provided each sample is clearly identified and its location recorded.

SD-06 Test Reports

Miscellaneous Metals and Standard Metal Articles[; G][; G, [____]]
Shop Fabricated Metal Items[; G][; G, [____]]

Certified test reports for materials tests and analyses shall be submitted for approval as specified and in Section 05 50 03.00 10 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.3 QUALIFICATIONS OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

PART 2 PRODUCTS

2.1 MISCELLANEOUS METALS AND STANDARD METAL ARTICLES

Miscellaneous metal materials and standard metal articles shall conform to the respective specifications and other designated requirements. Sizes shall be as specified or shown. Where material requirements are not specified, materials furnished shall be suitable for the intended use and shall be subject to approval.

2.1.1 Structural Steel

[[ASTM A 36/A 36M] [ASTM A 572/A 572M] Grade [____], Type [____]] [ASTM A 588/A 588M, Grade [____]].

2.1.2 Steel Plates

2.1.2.1 Structural

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

2.1.2.2 Pressure Vessel

ASTM A 516/A 516M, Grade [____], and shall meet the requirements of the Charpy V-notch impact tests and the drop-weight tests as specified in ASTM A 20/A 20M.

2.1.3 Steel Tubing

2.1.3.1 Structural

ASTM A 500, Grade [____], [[ASTM A 501] [ASTM A 618], Grade [____]], [seamless] [welded], [outside diameter] [outside dimensions] and nominal wall thickness as shown.

2.1.3.2 Mechanical

ASTM A 519 [seamless carbon] [alloy steel mechanical tubing], [hot finished] [cold finished], Conditions [____] and [____], Grade dimensions as shown.

2.1.4 Steel Pipes and Pipe Fittings

2.1.4.1 Pipes

ASTM A 53/A 53M, Type [E][S], Grade [A][B], [seamless] [electric-resistance welded], [black] [galvanized], nominal size and weight class or outside diameter and nominal wall thickness as shown, [plain] [threaded] [threaded and coupled] ends.

2.1.4.2 Pipe Fittings

- a. Flanged - ASME B16.5, Class [____], faced and drilled.
- b. Screwed - ASME B16.3, Type [____].
- c. Butt-welding - ASME B16.9.

2.1.5 Stainless Steel

NOTE: UNS S30400, S40500, and S41000 are low strength alloys suitable for use in welded assemblies. UNS S21800 is an intermediate strength alloy with excellent anti-galling characteristics. UNS S17400 and S45000 are high strength alloys. Welding of UNS S21800, S17400, and S45000 should be avoided.

2.1.5.1 Plate, Sheet, and Strip

ASTM A 240/A 240M, UNS [S30400,] [S40500] or [S41008]. Plate finish shall be hot-rolled and annealed or heat treated, and blast cleaned or pickled. Sheet and strip finish shall be No. 1.

2.1.5.2 Clad Plate

NOTE: Thickness of cladding may have to be changed for some applications.

ASTM A 263, with cladding conforming to ASTM A 240/A 240M, UNS S40500 or S41008; or ASTM A 264, with cladding conforming to ASTM A 240/A 240M, UNS S30400. Cladding shall be bonded on one side of base metal. Nominal thickness of the cladding shall be 10 percent of the nominal total plate thickness or 2 mm 1/16 inch, whichever is greater. The thickness of the cladding shall not vary under the thickness specified by more than 2 percent of the nominal thickness of the clad plate. Plate finish shall be sandblasted, pickled, or, blast-cleaned and pickled. Stainless steel plate specified above in paragraph PLATE, SHEET, AND STRIP may be used in lieu of clad plate at the option of the Contractor.

2.1.5.3 Bars and Shapes

Stainless steel bars and shapes shall conform to the following as specified or shown:

- a. ASTM A 276, UNS [S30400, S40500, or S41000 with a maximum carbon

content of 0.08 percent] [S21800], Condition A, hot-finished or cold-finished, Class C.

b. [ASTM A 564/A 564M](#), UNS S17400 or S45000, age-hardened heat treatment condition, hot-finished or cold-finished, Class C.

2.1.5.4 Plates, Bars & Shapes for Roller & Track Systems

NOTE: Rollers and track plates on gates and in gate slots which are subjected to hydraulic loads from water during operation of gates should be hardened by heat treatment as specified below in subparagraph GATE ROLLERS AND BOLTED TRACK PLATES. Hardened track plates are not suitable for welding and should be bolted in place. Track plates which are lightly loaded, such as gate upstream track plates, should conform to subparagraph WELDED SEAL PLATES AND BARS; WELDED ROLLER GUIDE BARS; AND WELDED TRACK PLATES below and be welded in place.

a. Gate Rollers and Bolted Track Plates - [ASTM A 564/A 564M](#), UNS S17400 or S45000, age-hardened heat treated to obtain a Brinell hardness range of 331 minimum to 401 maximum, hot-finished or cold-finished, Class C. Heat treatment of rollers and plates shall not commence until the heat treatment procedure and the test reports for other required material tests are approved. After heat treating and final machining, each roller and track plate shall be free of scale and cracks, as determined by magnetic particle, florescent, or dye penetrant inspection tests.

(1) Hardness Check Tests - Suitable [13 mm 1/2 inch](#) thick samples of the material from each heat shall be tested to determine the hardness in both the solution-annealed and age-hardened conditions. Where the oven-batch heat-treating process is used, hardness check tests shall be performed on material of each heat in each oven batch. Where a continuous heat-treating process is used, three check tests shall be performed on material of each heat: one on the first material through the process, one at the middle of the run, and one on the last material through the process.

b. Fasteners for Bolted Track Plates and Guide Bars - Bolting materials shall conform to [ASTM A 193/A 193M](#) or [ASTM A 320/A 320M](#), Class 2, Grade B8 Nuts shall conform to [ASTM A 194/A 194M](#), Grade 8A.

c. Gate Roller Links and Pins

(1) Links - [ASTM A 276](#), UNS S30400 or S41000, Condition A, hot-finished or cold-finished, Class A.

(2) Pins - [ASTM A 276](#), UNS S21800, Condition A, cold-finished or hot-rolled and machine-finished to the tolerances specified in [ASTM A 484/A 484M](#) for cold-finished round bars, Class C.

NOTE: It is contemplated that the pin diameter and tolerances shown will be the minimum size and

tolerances as given in ASTM A 484/A 484M for cold finished round bars. Machined pins should have a surface roughness of not exceeding 1.6 micrometers (63 microinches). Minimum diameter of holes in bars shall be the maximum pin size plus an allowance of 0.2 mm (0.008 inch) for a free fit. Minimum diameter of holes in rollers should be the nominal diameter of the pin plus 1 mm (1/32 inch). The length of the pin between retainer ring grooves should be based on the maximum width of the roller, the maximum thickness of the hot-finished bars rolled to the tolerances given in ASTM A 484/A 484M plus a clearance of approximately 1 mm (0.040 inch) to avoid binding between bars, or binding between bars and rollers.

d. Retaining rings for gate roller links shall be corrosion resistant steel conforming to [ASME B27.7](#), BASIC external series type with nominal ring size of [_____] mm inches.

e. Seal Plates, Bars, and Retainers; Roller Guide Bars; and Track Plates.

(1) Welded Seal Plates and Bars; Welded Roller Guide Bars; and Welded Track Plates - [ASTM A 240/A 240M](#), UNS [S40500] [S41008] [S30400], Hot-Rolled and Annealed or Heat Treated, and Blast Cleaned or Pickled Finish; or [ASTM A 276](#), UNS S30400, S40500, or S41000 with a maximum carbon content of 0.08 percent, Condition A, Hot-Finished or Cold-Finished, Class C.

(2) Bolted Seal Plates, Bars, and Retainers; and Bolted Roller Guide Bars - [ASTM A 240/A 240M](#), UNS [S40500] or [S41008] [S30400], Hot-Rolled and Annealed or Heat Treated, and Blast Cleaned or Pickled finish; or [ASTM A 276](#), UNS S30400, S40500, or S41000, Condition A, hot-finished or cold-finished, Class C.

2.1.5.5 Pipe

[ASTM A 312/A 312M](#), [seamless] [welded], UNS S30400, NPS and schedule number or outside diameter and nominal wall thickness as shown, [plain] [threaded] [threaded and coupled] ends.

2.1.6 Steel Forgings

2.1.6.1 General Industrial Use

[ASTM A 668/A 668M](#), Class [____], carbon content not exceeding 0.35 percent, and an overall chemical composition which results in satisfactory weldability.

2.1.6.2 Railway Use

[ASTM A 730](#), Grade [____], carbon content not exceeding 0.35 percent and an overall chemical composition which results in satisfactory weldability.

2.1.7 Steel Castings

[ASTM A 27/A 27M](#), Grade [____], Class [____], or [ASTM A 148/A 148M](#), Grade

[____].

2.1.1.8 Steel Strips

ASTM A 109/A 109M, [oiled] [not oiled], Temper [____] Edge [____], Finish [____].

2.1.1.9 Aluminum

2.1.1.9.1 Sheets and Plates

ASTM B 209M ASTM B 209, Alloy [____], Temper [____].

2.1.1.9.2 Bars, Rods and Wire

ASTM B 211M ASTM B 211, Alloy [____], Temper [____].

2.1.1.9.3 Structural Shapes

ASTM B 308/B 308M, Alloy [____], Temper [____].

2.1.1.9.4 Castings

ASTM B 26/B 26M, Alloy [____], Temper [____].

2.1.1.9.5 Pipes and Tubes

ASTM B 241/B 241M, Alloy 6063, Temper [____], size and schedule number or outside diameter and wall thickness as shown.

2.1.1.10 Bronze

2.1.1.10.1 Copper Alloy Castings

NOTE: After the specific ASTM casting specification and Alloy UNS Number has been selected, the general requirements of ASTM B 824 should be specified as needed based upon the application and importance of the component. ASTM B 828 establishes a group of general requirements common to the ASTM Copper Alloy Casting specifications. These requirements include pressure tests, certification, witness inspection, etc. Additionally, some of the specific copper alloy casting specifications have optional requirements which should be added if they are determined necessary. These optional requirements can include, but are not limited to, soundness, mechanical properties, and chemical analysis of residual elements.

[ASTM B 148] [ASTM B 62] [ASTM B 176] [ASTM B 271] [ASTM B 505/B 505M] [ASTM B 584] [ASTM B 763] [ASTM B 806], Copper Alloy UNS No. [____].

a. General requirements of ASTM B 824:

(1) Pressure tests

(2) Certification

(3) Witness tests

(4) [_____]

b. Optional requirements of [ASTM B 148] [ASTM B 62] [ASTM B 176] [ASTM B 271] [ASTM B 505/B 505M] [ASTM B 584] [ASTM B 763] [ASTM B 806] [ASTM B 824].

(1) Soundness

(2) Mechanical properties

(3) Chemical analysis of residual elements

(4) [_____]

2.1.10.2 Aluminum Bronze Castings

[ASTM B 148] [ASTM B 271] [ASTM B 505/B 505M] [ASTM B 763] [ASTM B 806],
Copper Alloy UNS No. [_____].

2.1.10.3 Aluminum Bronze Rods, Bars, and Shapes

ASTM B 150/B 150M, Copper Alloy UNS No. [_____], Temper [_____].

2.1.10.4 Manganese Bronze Castings

[ASTM B 176] [ASTM B 271] [ASTM B 505/B 505M] [ASTM B 584] [ASTM B 763],
Copper Alloy UNS No. [_____].

2.1.10.5 Rolled Manganese Bronze and Manganese Bronze Forgings

ASTM B 138/B 138M ASTM B 138/B 138M, Class [_____], Temper [_____].

2.1.10.6 Manganese Bronze Rods, Bars, and Shapes

ASTM B 138/B 138M ASTM B 138/B 138M, Copper Alloy UNS No. [_____],
Temper [_____].

2.1.11 Brass

2.1.11.1 Sheet, Plates, and Bars

[ASTM B 36/B 36M] [ASTM B 121/B 121M], Composition [_____], Temper [_____].

2.1.11.2 Castings

[ASTM B 62] [ASTM B 176] [ASTM B 271] [ASTM B 505/B 505M] [ASTM B 584] [ASTM B 763] [ASTM B 806], Copper Alloy UNS No. [_____].

2.1.11.3 Naval Brass

[ASTM B 21/B 21M,] [ASTM B 124/B 124M,] Composition [_____], Temper [_____].

2.1.12 Copper Flat Products

ASTM B 152/B 152M, Temper [_____].

2.1.13 Lead Sheet

ASTM B 749, Alloy UNS No. [____], Type [L____].

2.1.14 Zinc

ASTM B 6, [Special High Grade] [High Grade] [Prime Western].

2.1.15 Babbit Metal

ASTM B 23, Alloy UNS No. [____].

2.1.16 Bolts, Nuts, and Washers

Bolts, nuts, and washers shall be of the material, grade, type, class, style and finish indicated or best suited for intended use.

2.1.16.1 High-Strength Bolts, Nuts, and Washers

ASTM A 325M ASTM A 325, Type [____], [hot-dip galvanized] or ASTM A 490M ASTM A 490, Type [____].

a. Slip Critical Connections shall meet the requirements of Section 11 of AASHTO HB-17. Rotational-capacity testing shall be conducted for all fastener assemblies. Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly. A rotational-capacity lot number shall be assigned to each combination of lots tested. Bolts shall be tested in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device.

2.1.16.2 Bolts, Nuts, and Washers (Other Than High-Strength)

a. Bolts and Nuts - ASTM A 307, Grade A, [hot-dip galvanized] or ASTM A 320/A 320M, [Ferritic Steel, Grade [____]] [Austenitic Steel, Class [____]].

b. Bolts - ASME B18.2.1.

c. Nuts - ASME B18.2.2.

d. Washers

(1) Plain Washers - ASME B18.22M ASME B18.22.1, Type B.

(2) Lock Washer - ASME B18.21.1.

(3) Beveled Washers - ASTM F 436M ASTM F 436, Type [____], Beveled.

2.1.17 Screws

Screws shall be of the material, grade, type, style, and finish indicated or best suited for use intended.

2.1.17.1 Cap Screws

ASME B18.2.1, ASME B18.3, or ASME B18.6.2 as required.

2.1.17.2 Machine Screws

ASME B18.6.3.

2.1.17.3 Wood Screws

ASME B18.6.1.

2.1.17.4 Set Screws

ASME B18.6.2.

2.1.18 Expansion Anchors

NOTE: The designer should replace FS FF-S-325 Groups with the following: CID A-A-1922 replaces Group I; CID A-A-1923 replaces Group II; CID A-A-1924 replaces Group III; CID A-A-55615 with Group IV; CID A-A-1925 replaces Group V; and CID A-A-55614 replaces Group VIII.

[CID A-A-1922] [CID A-A-1923] [CID A-A-1924] [CID A-A-1925] [CID A-A-55614] [CID A-A-55615], type as required, except that nail driven types will not be acceptable, galvanized unless otherwise indicated.

2.1.19 Toggle Bolts

Toggle bolts shall have spring action snap open wings and require a predrilled hole. Screws and sheet metal wings shall be made of zinc-plated steel.

2.1.20 Rivets

Rivets shall conform to [____], Grade [____].

2.1.21 Safety Treads

Treads shall slip-on skid resistant and made from [rubber] [vinyl] [aluminum alloy] [cast iron] as best suited for the intended location.

2.1.22 Wire Rope

NOTE: Identify the requirements for wire rope by inserting number of wires, material, type of core, lay, coating, and whether preformed or not.

FS RR-W-410, Type [____], Class [____], Construction [____], [wire sizes] [strand seizing] as shown.

2.1.23 Chains and Attachments

FS RR-C-271, Type [____], Grade [____], Class [____], Style [____], Size [____], Finish [____].

2.1.24 Steel Rails

ASTM A 1, [No. 1] [No. 2].

2.1.25 Cast Iron Frames and Covers

CID A-A-60005, Type [____], Style [____] frame, type [____] cover.

2.1.26 Steel Wheels

ASTM A 504/A 504M, Class [____], design and rough bore size as shown.

2.1.27 Gratings

NOTE: When choosing grating size, welded cross members should not be less than 2.52 square mm (1/16-square inch) in cross-sectional area. Galvanizing adds approximately 5% to the weight of the average grating.

NAAMM MBG 531 and NAAMM MBG 531S.

a. Description of grating: [____].

b. Anchorage: [____].

c. Finish: [steel] [steel zinc-coated in accordance with ASTM A 123/A 123M after fabrication, and steel hardware and fasteners completely zinc-coated in accordance with ASTM A 153/A 153M] [stainless steel] [aluminum].

2.1.28 Steel Floor Plate

ASTM A 786/A 786M, Pattern No. [1] [2] [3] [4] [5].

2.2 SHOP FABRICATED METAL ITEMS

Shop fabricated metal items shall conform to the requirements and details as specified or shown and to the workmanship provisions and other applicable fabrication requirements as specified in Section 05 50 03.00 10 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.2.1 Railings

Railings shall be of the type specified and shown and shall be furnished and installed complete with all fittings, brackets, fasteners, sleeves, anchors, and other appurtenances as shown and as required for proper installation. Handrails shall be designed at a minimum to resist a concentrated load of 890 N 200 lbf in any direction at any point of the top of the rail or 30 kg/m 20 lb/ft applied horizontally to top of the rail, whichever is more severe.

2.2.1.1 Materials

Steel handrails, including inserts in concrete, shall be [steel pipe conforming to ASTM A 53/A 53M] [or] [structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength]. Steel railings shall be

[38] [20] mm [1-1/2] [2] inch nominal size. Railings shall be [hot-dip galvanized] [and] [shop painted]. Pipe collars shall be [steel.] [hot-dip galvanized steel.] [stainless steel.] Aluminum handrails shall consist of [38] [50] mm [1-1/2] [2] inch nominal Schedule 40 pipe ASTM B 429 [45 mm 1-3/4 inch square aluminum semi-hollow tube with rounded corners ASTM B 221]. Railings and pipe collars shall be [mill finish] [anodized] [aluminum [] color]. All fasteners shall be Series 300 stainless steel.

2.2.1.2 Fabrication

NOTE: Flush-finished joints should be specified for railings when a good appearance is desired.

Rigid joints in railings shall be of welded, threaded, or slip-on fittings assembly [and shall be flush-finished]. Welded joints shall be reinforced with tight-fitting interior sleeves and shall be assembled by welding rails and posts to flush-type fittings, or by mitering and welding joining rails and posts. Assembled threaded joints shall have no exposed threads. Slip-on fittings shall be tight-fitting. Fasteners for slip-on fittings shall be the self-locking, concealed type. Fasteners for aluminum fittings shall be of aluminum or stainless steel. Fasteners for steel fittings shall be of stainless steel. Expansion joints in railings shall be an [inner-sleeved] [outer-sleeved] [outer-sleeved or inner-sleeved] slip-joint, with one end of the sleeve secured to one rail and the ends of the adjoining rails separated a minimum of 25 mm 1 inch in the installed position. Expansion joints shall be located in rails near the intersection of rails and posts. Bends in railings shall be made in a manner that railings are not crushed and shall maintain their original cross-sectional shape. Welds shall be ground smooth. Railings shall be free of burrs, sharp corners, and sharp edges. For railings of other than welded assembly, manufacturer design calculations, showing that the installed railings are capable of withstanding a design working load of [890] [] N [200] [] lbf applied in any direction at any point on the top rail without permanent deformation, must be submitted and approved prior to installation.

2.2.1.3 Installation

Railings shall be installed as specified and shown. Railing posts anchored to concrete surfaces perpendicular to the posts shall be [set in sleeve inserts anchored in the concrete, and the space between posts and sleeves shall be filled with a sealant or a quick-setting hydraulic cement and covered with standard collar fittings secured to the posts. A 6 mm 1/4 inch drain hole shall be drilled near the bottom of each post.] [rigidly secured to flange fittings anchored to concrete with expansion anchors.] Railing posts anchored to concrete surfaces parallel to the posts shall [have the sides of posts continuously welded to base plates] [be rigidly secured to flange fittings] anchored to concrete with expansion anchors. Railing posts anchored to structural metal shall be [welded to base plates] [rigidly secured to flange fittings] [bolted] [welded] to structural metal. Ends of rails anchored to concrete or masonry shall be rigidly secured to flange fittings anchored to concrete or masonry with expansion anchors.

2.2.2 Gratings and Cover Plates

Grating and cover plates shall be of the material and size shown, and shall be fabricated in sectional panels of the width and length shown, or as

appropriate, to accurately fit within the supporting recess frames. Openings through panels shall be provided as shown or as required. [Hinged panels shall be provided with hinges of the type shown or suitable for the application.] [Steel gratings and cover plates shall be galvanized after fabrication.]

2.2.2.1 Grating

Gratings shall be as specified in paragraph GRATINGS. Edges of gratings and openings through gratings which require the cutting of more than one bearing bar shall be banded. Fasteners shall be of the type recommended by the manufacturer and approved. [Stair tread gratings shall have nonslip nosings.]

2.2.2.2 Cover Plates

Cover plates shall be as specified in paragraph STEEL FLOOR PLATE. Cover plate panels shall be provided with [holes for insertion of removal tool] [6 mm 1/4 inch bar, flush, drop handles for removal] as shown or as required. Sharp edges and burrs shall be removed from plates.

2.2.3 Steel Stairs

Steel stairs shall be complete with structural or formed channel stringers, [steel plate treads and risers,] [metal pan cement-filled treads,] [grating treads,] [slip-resistant metallic treads,] landings, columns, handrails, and necessary bolts and other fastenings as indicated. Stringers shall have exposed ends closed [and shall be continued around landings which they support]. Structural steel shall conform to ASTM A 36/A 36M. Stairs and accessories shall be [galvanized after fabrication] [_____]. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill. Stair treads [and landings] shall be fabricated of steel gratings of the type specified in paragraph GRATING. Grating treads shall have slip-resistant nosings. Bolts, nuts and other fastenings shall be provided as shown and as required for proper installation. Lock washers shall be used under all nuts. [Railings of the type specified above in paragraph RAILINGS shall be anchored to stairs as shown.]

2.2.4 Recess Frames

Recess frames shall be fabricated of structural shapes of the type shown. Welded joints in frames shall be ground smooth. [Steel frames shall be galvanized after fabrication.] Frames shall be anchored to supports in the manner shown and shall not be continuous across contraction or expansion joints.

2.2.5 Ladders

Ladders shall be fixed-rail metal ladders conforming to the requirements of EM 385-1-1 and to details shown. Ladders shall be fabricated of [structural steel as shown and shall be galvanized after fabrication] [aluminum as shown]. Fabrication of ladders shall consist of solid-section rod rungs fitted into holes in bar side rails and welded. Splices in side rails shall be made using full penetration welds and shall provide a flush and smooth transition between connecting ends. All welds shall be ground smooth. Ladder rails shall be welded to bent-bar supporting brackets anchored to supporting structure as shown.

2.2.6 [Ladder Rungs] [Grab Bars] [Pulling Irons] [Mooring Rings]

[Ladder rungs], [grab bars], [pulling irons], [mooring rings] shall be fabricated from steel rods in accordance with the details and shall be galvanized after fabrication.

2.2.7 Lock Wall Armor

Lock wall armor tees and preformed corner protection plates shall be fabricated from steel conforming to [ASTM A 36/A 36M](#), except that minimum yield strength shall be [230 MPa 33,000 psi](#), maximum tensile strength shall be waived, and the maximum allowable manganese content shall be 1.40 percent. Tees may be commercially rolled sections or may be fabricated from steel plates provided they have a nominal weight of not less than [42.0 kg/m 28.2 pounds/foot](#) and conform essentially to details shown. Installation shall conform to details shown. Tees and preformed plates shall be erected true to line and grade. The continuous edges of exposed faces shall not have a vertical or horizontal distortion from a straight line greater than [2 mm/m 0.025 inch/foot](#) of length. Distortion for any single section shall not exceed [36 mm 1.4 inches](#). Where there is a warp in the installed tees or preformed plates greater than [2 mm 1/16 inch](#), an extra anchor shall be installed at the proper location to draw the section into position. Bolt heads on exposed faces shall be counter sunk and fitted so that they are flush with the finished surfaces. Joints between abutting sections shall be square and the butting ends shall be sawed or otherwise made smooth and regular.

2.2.8 Lock Wall Line Hooks and Check Posts

Lock wall line hooks and check posts shall be fabricated of alloy steel mechanical tubing as specified in paragraph MECHANICAL. Dimensions, including outside diameter and wall thickness, and anchor bars shall be as shown.

2.2.9 Guy Cables

Guy cables shall be prestretched, galvanized wire rope of the sizes indicated. Wire rope shall conform to [ASTM A 475](#), high strength grade with Class A coating. Guys shall have a factory attached clevis top-end fitting; guys shall have a factory attached open-bridge strand socket bottom-end fitting; guys shall be complete with oval eye, threaded anchor rods. Fittings and accessories shall be hot-dip galvanized.

2.2.10 Safety Chains

Safety chains shall be galvanized welded steel, proof coil chain tested in accordance with [ASTM A 467/A 467M](#), Class CS. Safety chains shall be straight link style, [5 mm 3/16 inch](#) diameter, minimum 12 links per foot and with bolt type snap hooks on each end. Eye bolts for attachment of chains shall be galvanized [10 mm 3/8 inch](#) bolt with [19 mm 3/4 inch](#) eye, anchored as indicated. Two chains shall be furnished for each guarded opening.

2.2.11 Surface Finishes

2.2.11.1 Galvanizing and Zinc Repair

Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with [ASTM A 123/A 123M](#), [ASTM A 653/A 653M](#), or

ASTM A 924/A 924M, as applicable. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 50 g 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 50 g 2 ounces shall be repaired in accordance with ASTM A 780.

2.2.11.2 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.11.3 Aluminum Surfaces

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces. Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF-45, or AA 46. Unless otherwise specified, all other aluminum items shall have [standard mill finish.] [hand sanded or machine finish to a 240 grit.] [anodized finish.] The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with [AWS D1.1/D1.1M](#). Use continuous welds on all exposed connections. GRIND VISIBLE WELDS SMOOTH IN THE FINISHED INSTALLATION.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to [SSPC Paint 25](#) to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with [ASTM D 1187](#), asphalt-base emulsion.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than [3 degrees C](#) [5 degrees F](#) above the dew point of the surrounding air, or when surface temperature is below [7 degrees C](#) [45 degrees F](#) or over [35 degrees C](#) [95 degrees F](#), unless approved by the Contracting Officer.

3.6 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.6.1 Installation of Steel Handrails

Installation shall be by means of pipe sleeves secured to [wood with screws.] [masonry with expansion shields and bolts or toggle bolts.] [base plates bolted to stringers or structural steel framework.] Rail ends shall be secured by steel pipe flanges [anchored by expansion shields and bolts.] [through-bolted to a back plate or by [6 mm](#) [1/4 inch](#) lag bolts to studs or solid backing.]

3.6.2 Installation of Aluminum Handrails

Installation shall be by means of [flanges anchored to concrete or masonry by expansion shields] [base plates or flanges bolted to stringers or structural steel framework] [flanges through-bolted to a back plate or by 6 mm 1/4 inch lag bolts to studs or other structural members]. Bolts used to anchor aluminum alloy flanges shall be stainless steel of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphalt varnish.

3.7 MOUNTING OF SAFETY CHAINS

Safety chains shall be mounted 1 m 3 feet 6 inches and 600 mm 2 feet above the floor.

3.8 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

3.9 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. [Secure to masonry or concrete with not less than two 13 mm 1/2 inch diameter expansion bolts.] Install intermediate clip angles not over 1200 mm 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. In no case shall ends of ladders rest upon [finished roof] [floor].

3.10 STEEL STAIRS

Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Provide lock washers under nuts.

3.11 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

NOTE: Details of pipe guard installation will be
shown on the drawings.

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete [specified in Section 03 31 00.00 10CAST-IN-PLACE STRUCTURAL CONCRETE] [having a compressive strength of 21 MPa 3000 psi].

-- End of Section --