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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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CIVIL WORKS FABRICATIONS
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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. This section was originally developed for USACE Civil Works projects.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
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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 Reference Identifier (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 DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)
ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.22M	(1981; R 2017) Metric Plain Washers
ASME B18.27	(1998; R 2017) Tapered and Reduced Cross Section Retaining Rings (Inch Series)

ASME B27.7	(1977; R 2017) General Purpose Tapered and Reduced Cross Section Retaining Rings

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.3	(2013) Safety Requirements for Powder-Actuated Fastening Systems American National Standard for Construction and Demolition Operations

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1	(2000; R 2018) Standard Specification for Carbon Steel Tee Rails
ASTM A20/A20M	(2018) Standard Specification for General Requirements for Steel Plates for Pressure Vessels
ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A48/A48M	(2003; R 2016) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A109/A109M	(2016; R 2018) Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A148/A148M	(2020; E 2020) Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2020a) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

ASTM A240/A240M	(2020) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A263	(2012; R 2019) Standard Specification for Stainless Chromium Steel-Clad Plate
ASTM A264	(2012; R 2019) Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2019) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320/A320M	(2017b) Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A467/A467M	(2020) Standard Specification for Machine Coil Chain
ASTM A475	(2003; R 2020) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A484/A484M	(2020b) Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A500/A500M	(2020) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A504/A504M	(2018) Standard Specification for Wrought Carbon Steel Wheels
ASTM A516/A516M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A519/A519M	(2017) Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A564/A564M	(2019) Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening

	Stainless Steel Bars and Shapes
ASTM A572/A572M	(2018) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	(2019) Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A668/A668M	(2020a) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	(2015a) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM A1085/A1085M	(2015) Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM B6	(2018) Standard Specification for Zinc
ASTM B21/B21M	(2020) Standard Specification for Naval Brass Rod, Bar, and Shapes
ASTM B23	(2020) Standard Specification for White Metal Bearing Alloys (known Commercially as "Babbitt Metal")
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B36/B36M	(2018) Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings

ASTM B121/B121M	(2016) Standard Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B124/B124M	(2020) Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes
ASTM B138/B138M	(2011; R 2017) Standard Specification for Manganese Bronze Rod, Bar and Shapes
ASTM B148	(2014) Standard Specification for Aluminum-Bronze Sand Castings
ASTM B150/B150M	(2012; R 2017) Standard Specification for Aluminum Bronze Rod, Bar, and Shapes
ASTM B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B176	(2018) Standard Specification for Copper-Alloy Die Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B211/B211M	(2019) Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B241/B241M	(2016) Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B271/B271M	(2015) Standard Specification for Copper-Base Alloy Centrifugal Castings
ASTM B308/B308M	(2010; R 2020) Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B505/B505M	(2018) Standard Specification for Copper Alloy Continuous Castings
ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B749	(2020) Standard Specification for Lead and

	Lead Alloy Strip, Sheet and Plate Products
ASTM B763/B763M	(2015) Standard Specification for Copper Alloy Sand Castings for Valve Application
ASTM B806	(2014) Standard Specification for Copper Alloy Permanent Mold Castings for General Applications
ASTM B824	(2017) Standard Specification for General Requirements for Copper Alloy Castings
ASTM C1513	(2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2017) Metal Bar Grating Manual
NAAMM MBG 532	(2009) Heavy Duty Metal Bar Grating Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	(2002; E 2004) Zinc Dust Sacrificial Primer, Performance-Based

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60005	(Basic; Notice 2) Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole
FS RR-C-271	(Rev G) Chains and Attachments, Carbon And Alloy Steel
FS RR-W-410	(2020; Rev J) Wire Rope and Strand

1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Fabricated Metal Items; G[, [_____]]

SD-03 Product Data

Expansion Anchors

Sleeve Anchors

Adhesive Anchors

Powder Driven Fasteners

Wire Rope

Gratings

Stairs

Ladders

Shop Fabricated Metal Items; G[, [_____]]

SD-04 Samples

Shop Fabricated Metal Items; G[, [_____]]

SD-06 Test Reports

Hardness Check

Rotational Capacity

SD-07 Certificates

Welder Certifications

1.3 QUALITY ASSURANCE

a. Form miscellaneous metalwork to shape and size, with sharp lines and angles and true curves. Drill and punch producing clean true lines and surfaces. Provide exposed surfaces of work in place with a smooth finish, and unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

b. Perform welding continuously along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place. Grind exposed welds smooth.

c. Qualify welders, perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work. Submit welder certifications for each welder stating the type of welding and position 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 6 months old, the welding operator's qualification certificate must 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.]

1.4 ENVIRONMENTAL REQUIREMENTS

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.

PART 2 PRODUCTS

2.1 MISCELLANEOUS METALS AND STANDARD METAL ARTICLES

Conform to the respective specifications and other designated requirements for miscellaneous metal materials and standard metal articles. Size as specified or indicated. Where material requirements are not specified, furnish materials suitable for the intended use and subject to approval.

2.1.1 Structural Steel

[[ASTM A36/A36M] [ASTM A992/A992M] [ASTM A572/A572M] Grade [_____], Type [_____]] [ASTM A588/A588M, Grade [_____]].

2.1.2 Steel Plates

2.1.2.1 Structural

[ASTM A572/A572M, Grade 50] [ASTM A36/A36M].

2.1.2.2 Pressure Vessel

ASTM A516/A516M, Grade [_____], and meet the requirements of the Charpy V-notch impact tests and the drop-weight tests as specified in ASTM A20/A20M.

2.1.3 Steel Tubing

2.1.3.1 Structural

ASTM A500/A500M, Grade B, [ASTM A1085/A1085M] [seamless] [welded], [outside diameter] [outside dimensions] and nominal wall thickness as shown.

2.1.3.2 Mechanical

ASTM A519/A519M [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 A53/A53M, 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

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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. Avoid welding of UNS S21800, S17400, and S45000.
****

2.1.5.1 Plate, Sheet, and Strip

ASTM A240/A240M, UNS [S30400,] [S40500] or [S41008]. Plate finish must be hot-rolled and annealed or heat treated, and blast cleaned or pickled. Provide No. 1 sheet and strip finish.

2.1.5.2 Clad Plate

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

ASTM A263, with cladding conforming to ASTM A240/A240M, UNS S40500 or S41008; or ASTM A264, with cladding conforming to ASTM A240/A240M, UNS S30400. Bond cladding on one side of base metal. Nominal thickness of the cladding must be 10 percent of the nominal total plate thickness or 2 mm 1/16 inch, whichever is greater. Do not vary the thickness of the cladding under the thickness specified by more than 2 percent of the nominal thickness of the clad plate. Provide sandblasted, pickled, or, blast-cleaned and pickled plate finish. 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

Conform to the following, as specified or shown, for stainless steel bars and shapes:

a. ASTM A276/A276M, 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 A564/A564M, UNS S17400 or S45000, age-hardened heat treatment condition, hot-finished or cold-finished, Class C.

2.1.5.4 Plates, Bars and Shapes for Roller and Track Systems

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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.

****

2.1.5.4.1 Gate Rollers and Bolted Track Plates

ASTM A564/A564M, 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. Do not commence heat treatment of rollers and plates 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 must be free of scale and cracks, as determined by ultrasonic, magnetic particle or dye penetrant inspection tests.

2.1.5.4.2 Hardness Check Tests

Test suitable 13 mm 1/2 inch thick samples of the material from each heat to determine the hardness in both the solution-annealed and age-hardened conditions. Where the oven-batch heat- treating process is used, perform hardness check tests on material of each heat in each oven batch. Where a continuous heat-treating process is used, perform three check tests 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. Submit test report for hardness check.

2.1.5.4.3 Fasteners for Bolted Track Plates and Guide Bars

Conform to ASTM A193/A193M or ASTM A320/A320M, Class 2 for bolting materials, Grade B8, Conform to ASTM A194/A194M, Grade 8A for nuts.

2.1.5.4.4 Gate Roller Links and Pins

2.1.5.4.4.1 Links

ASTM A276/A276M, UNS S30400 or S41000, Condition A, hot-finished or cold-finished, Class A.

2.1.5.4.4.2 Pins

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NOTE: It is contemplated that the pin diameter and tolerances shown will be the minimum size and tolerances as given in ASTM A484/A484M 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

should 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. Base the length of the pin between retainer ring grooves on the maximum width of the roller, the maximum thickness of the hot-finished bars rolled to the tolerances given in ASTM A484/A484M plus a clearance of approximately 1 mm 0.040 inch to avoid binding between bars, or binding between bars and rollers.
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ASTM A276/A276M, UNS S21800, Condition A, cold-finished or hot-rolled and machine-finished to the tolerances specified in ASTM A484/A484M for cold-finished round bars, Class C.

2.1.5.4.5 Retaining Rings

Provide corrosion resistant steel retaining rings for gate roller links conforming to ASME B27.7ASME B18.27, BASIC external series type with nominal ring size of [_____] mm inches.

2.1.5.4.6 Seal Plates, Bars, and Retainers; Roller Guide Bars; and Track Plates

2.1.5.4.6.1 Welded Seal Plates and Bars; Welded Roller Guide Bars; and Welded Track Plates

ASTM A240/A240M, UNS [S40500] [S41008] [S30400], Hot-Rolled and Annealed or Heat Treated, and Blast Cleaned or Pickled Finish; or ASTM A276/A276M, UNS S30400, S40500, or S41000 with a maximum carbon content of 0.08 percent, Condition A, Hot-Finished or Cold-Finished, Class C.

2.1.5.4.6.2 Bolted Seal Plates, Bars, and Retainers; and Bolted Roller Guide Bars

ASTM A240/A240M, UNS [S40500] or [S41008] [S30400], Hot-Rolled and Annealed or Heat Treated, and Blast Cleaned or Pickled finish; or ASTM A276/A276M, UNS S30400, S40500, or S41000, Condition A, hot-finished or cold-finished, Class C.

2.1.5.5 Pipe

ASTM A312/A312M, [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 A668/A668M, 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 A668/A668M, Grade [_____], carbon content not exceeding 0.35 percent and an overall chemical composition which results in satisfactory

weldability.

2.1.7 Steel Castings

ASTM A27/A27M, Grade [_____], Class [_____], or ASTM A148/A148M, Grade [_____].

2.1.8 Steel Strips

ASTM A109/A109M, [oiled] [not oiled], Temper [_____] Edge [_____], Finish [_____].

2.1.9 Aluminum

2.1.9.1 Sheets and Plates

ASTM B209M ASTM B209, Alloy [_____], Temper [_____].

2.1.9.2 Bars, Rods and Wire

ASTM B211/B211M, Alloy [_____], Temper [_____].

2.1.9.3 Structural Shapes

ASTM B308/B308M, Alloy [_____], Temper [_____].

2.1.9.4 Castings

ASTM B26/B26M, Alloy [_____], Temper [_____].

2.1.9.5 Pipes and Tubes

ASTM B241/B241M, Alloy 6063, Temper [_____], size and schedule number or outside diameter and wall thickness as shown.

2.1.10 Bronze

2.1.10.1 Copper Alloy Castings

****

NOTE: After the specific ASTM casting specification and Alloy UNS Number has been selected, specify the general requirements of ASTM B824 as needed based upon the application and importance of the component. ASTM B828 establishes a group of general requirements common to the ASTM Copper Alloy Casting specifications. These requirements might include pressure tests, certification, or witness. 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 B148] [ASTM B62] [ASTM B176] [ASTM B271/B271M] [ASTM B505/B505M] [ASTM B584] [ASTM B763/B763M] [ASTM B806], Copper Alloy UNS No. [_____].

a. General requirements of ASTM B824:

(1) Hydrostatic tests

(2) Certification

(3) Soundness tests

(4) [_____]

b. Optional requirements of [ASTM B148] [ASTM B62] [ASTM B176] [ASTM B271/B271M] [ASTM B505/B505M] [ASTM B584] [ASTM B763/B763M] [ASTM B806] [ASTM B824].

(1) Soundness

(2) Mechanical properties

(3) Chemical analysis of residual elements

(4) [_____]

2.1.10.2 Aluminum Bronze Castings

[ASTM B148] [ASTM B271/B271M] [ASTM B505/B505M] [ASTM B763/B763M] [ASTM B806], Copper Alloy UNS No. [_____].

2.1.10.3 Aluminum Bronze Rods, Bars, and Shapes

ASTM B150/B150M, Copper Alloy UNS No. [_____], Temper [_____].

2.1.10.4 Manganese Bronze Castings

[ASTM B176] [ASTM B271/B271M] [ASTM B505/B505M] [ASTM B584] [ASTM B763/B763M], Copper Alloy UNS No. [_____].

2.1.10.5 Rolled Manganese Bronze and Manganese Bronze Forgings

ASTM B138/B138M ASTM B138/B138M, Class [_____], Temper [_____].

2.1.10.6 Manganese Bronze Rods, Bars, and Shapes

ASTM B138/B138M ASTM B138/B138M, Copper Alloy UNS No. [_____], Temper [_____].

2.1.11 Brass

2.1.11.1 Sheet, Plates, and Bars

[ASTM B36/B36M] [ASTM B121/B121M], Composition [_____], Temper [_____].

2.1.11.2 Castings

[ASTM B62] [ASTM B176] [ASTM B271/B271M] [ASTM B505/B505M] [ASTM B584] [ASTM B763/B763M] [ASTM B806], Copper Alloy UNS No. [_____].

2.1.11.3 Naval Brass

[ASTM B21/B21M,] [ASTM B124/B124M,] Composition [_____], Temper [_____].

2.1.12 Copper Flat Products

ASTM B152/B152M, Temper [_____].

2.1.13 Lead Sheet

ASTM B749, Alloy UNS No. [_____], Type [L_____].

2.1.14 Zinc

ASTM B6, [Special High Grade] [High Grade] [Prime Western].

2.1.15 Babbit Metal

ASTM B23, Alloy UNS No. [_____].

2.1.16 Bolts, Nuts, and Washers

Provide bolts, nuts, and washers 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

a. ASTM F3125/F3125M Grade [A325][A490], [hot-dip galvanized].

b. Conduct Rotational-capacity testing for all fastener assemblies in accordance with ASTM F3125/F3125M. Test as an assembly each combination of bolt production lot, nut lot, and washer lot. Assign a rotational-capacity lot number to each combination of lots tested. Test bolts in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device. Submit test report for rotational capacity.

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

a. Bolts and Nuts - ASTM A307, Grade A, [hot-dip galvanized] or ASTM A320/A320M, [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 B18.21.1, Type B.

(2) Lock Washer - ASME B18.21.1.

(3) Beveled Washers - ASTM F436/F436M, Type [_____], Beveled.

2.1.16.3 Foundation Anchorage

****

NOTE: For most jobs, ASTM F1554 248 MPa 36 ksi anchor bolts are used. If high tensile loads are

anticipated, consider the use of 379 MPa or 724 MPa 55 ksi or 105 ksi ASTM F1554 anchor bolts. If stainless steel is considered, select from material in ASTM A193/A193M.
****

2.1.16.3.1 Anchor Rods

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

2.1.16.3.2 Anchor Nuts

ASTM A563M (ASTM A563), Grade A, hex style. [Stainless steel ASTM A193/A193M.]

2.1.16.3.3 Anchor Washers

ASTM F844. [Stainless steel [Type 304][Type 316] conforming to ASTM A276/A276M.]

2.1.16.3.4 Anchor Plate Washers

ASTM A36/A36M [Stainless steel [Type 304][Type 316] conforming to ASTM A276/A276M.]

2.1.17 [Expansion Anchors] [Sleeve Anchors] [Adhesive Anchors]

Provide [_____] mm inch diameter [expansion anchors][sleeve anchors][adhesive anchors]. Minimum [concrete][masonry] embedment must be [_____] mm in. Design values listed must be as tested according to ASTM E488/E488M.

a. Minimum [ultimate][allowable] pullout value: [_____] kN lb.

b. Minimum [ultimate][allowable] shear value: [_____] kN lb.

2.1.18 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.19 Toggle Bolts

ASME B18.2.1.

2.1.20 Powder Driven Fasteners

Follow safety provisions of ASSP A10.3.

2.1.21 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.1.22 Safety Treads

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

2.1.23 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.

2.1.24 Chains and Attachments

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

2.1.25 Steel Rails

ASTM A1, [No. 1] [No. 2].

2.1.26 Cast Iron Frames and Covers

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

2.1.27 Steel Wheels

ASTM A504/A504M, Class [_____], design and rough bore size as shown.

2.1.28 Gratings

****
NOTE: Use NAAM MBG 531 for gratings for pedestrian grates and use NAAM MBG 532 for vehicular grates not specified elsewhere.
****

a. Gray cast iron ASTM A48/A48M, Class 40.

b. Metal plank grating, non-slip requirement, aluminum ASTM B209M, ASTM B209, 6061-T6; steel ASTM A653/A653M, Z275 G90.

c. Metal bar type grating NAAMM MBG 531[NAAMM MBG 532].

2.1.29 Floor Plates, Patterned

Floor plate ASTM A786/A786M. Steel plate must not be less than 1.9 mm 14 gage.

2.1.30 Submittals Requirements

This applies to SHOP FABRICATED METAL ITEMS also. Submit the following:

a. Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Include in the drawings catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: [_____]

b. Lists of materials, and records which identify the disposition of

approved material and fabricated items in the work.

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

2.2 SHOP FABRICATED METAL ITEMS

Conform shop fabricated metal items 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 14 STRUCTURAL METAL FABRICATIONS.

2.2.1 Railings

Provide railings as type specified and show, furnish, and install complete with all fittings, brackets, fasteners, sleeves, anchors, and other appurtenances as shown and as required for proper installation. Design handrails to resist a minimum concentrated load of 890 N 200 lbf in any direction at any point of the top of the rail or 75 kg/m 50 lb/ft applied in any direction at the top of the rail, whichever is more severe.

2.2.1.1 Materials

Steel handrails, including inserts in concrete, provide [steel pipe conforming to ASTM A53/A53M] [or] [structural tubing conforming to ASTM A500/A500M, Grade A or B of equivalent strength] [ASTM A1085/A1085M]. Provide steel railings with [38] [20] mm [1-1/2] [2] inch nominal size. Hot-dip galvanize [and] [shop paint] railings. Provide pipe collars of [steel.] [hot-dip galvanized steel.] [stainless steel.] Provide aluminum handrails of [[38] [50] mm [1-1/2] [2] inch nominal Schedule 40 pipe ASTM B429/B429M] [45 mm 1-3/4 inch square aluminum semi-hollow tube with rounded corners ASTM B221]. Railings and pipe collars must be [mill finish] [anodized] [aluminum [_____] color]. Provide all fasteners of Series 300 stainless steel.

2.2.1.2 Fabrication

****
NOTE: Specify flush-finished joints for railings when a good appearance is desired.
****

Rigid joints in railings must be of welded, threaded, or slip-on fittings assembly [and be flush-finished]. Reinforce welded joints with tight-fitting interior sleeves assembled by welding rails and posts to flush-type fittings, or by mitering and welding joining rails and posts. Exposed threads are not permitted on assembled threaded joints. Use tight fitting slip-on fittings. Provide self-locking, concealed type fasteners for slip-on fittings. Provide aluminum or stainless steel fasteners for aluminum fittings. Provide stainless steel fasteners for steel fittings. Expansion joints in railings must 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. Locate expansion joints in rails near the intersection of rails and posts. Make bends in railings in a manner that railings are not crushed and maintain their

original cross-sectional shape. Ground welds smooth. Provide railings free of burrs, sharp corners, and sharp edges.

2.2.2 Gratings and Cover Plates

Provide grating and cover plates of the material and size shown, and fabricated in sectional panels of the width and length shown, or as appropriate, to accurately fit within the supporting recess frames. Provide openings through panels as shown or as required. [Provide hinged panels with hinges of the type shown or suitable for the application.] [Galvanize steel gratings and cover plates after fabrication.]

2.2.2.1 Grating

Gratings are as specified in previous paragraph GRATINGS. Band edges of gratings and openings through gratings which require the cutting of more than one bearing bar. Provide fasteners of the type recommended by the manufacturer and approved. [Provide nonslip nosing on stair tread gratings.]

2.2.2.2 Cover Plates

Provide cover plates as specified in paragraph FLOOR PLATES, PATTERNED. Provide cover plate panels with [holes for insertion of removal tool] [6 mm 1/4 inch bar, flush, drop handles for removal] as shown or as required. Remove sharp edges and burrs from plates.

2.2.3 Steel Stairs

Provide steel stairs 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. Close exposed ends of stringers [and continue around landings which they support]. Conform to ASTM A36/A36M for structural steel. Stairs and accessories must be [galvanized after fabrication] [_____]. Form risers on stairs with metal pan treads to form a sanitary cove to retain the tread concrete. Integral nosings must have braces extended into the concrete fill. [Fabricate stair treads [and landings] of steel gratings of the type specified in paragraph GRATING. Provide grating treads with slip-resistant nosings.]Provide bolts, nuts and other fastenings as shown and as required for proper installation. Use lock washers under all nuts. [Anchor railings of the type specified above in paragraph RAILINGS to stairs as shown.]

****

NOTE: For industrial or heavy duty stairs use live load = 5 times the expected load and a concentrated load of 2 kN 1000 lbs. For standard applications, use a live load of 500 kg per square m 100 psf and a concentrated load of 1.3 kN 300 lbs applied over and area of 50 mm by 50 mm 2 inches by 2 inches.

****

Design stairs to sustain a live load of not less than [_____] kg per square meter pounds per square foot, or a concentrated load of [_____] kN lbs applied over and area of 50 mm by 50 mm 2 inches by 2 inches where it is most critical. Conform to AISC 360 with the design and fabrication of steel stairs, other than a commercial product.

2.2.4 Recess Frames

Fabricate recess frames of structural shapes of the type shown. Grind welded joints in frames smooth. [Galvanize steel frames after fabrication.] Anchor frames to supports in the manner shown and not be continuous across contraction or expansion joints.

2.2.5 Ladders

Provide fixed-rail metal ladders conforming to the requirements of EM 385-1-1 and to details shown. Fabricate ladders of [structural steel as shown and be galvanized after fabrication] [aluminum as shown]. Fabricate ladders of solid-section rod rungs fitted into holes in bar side rails and weld. Make splices in side rails using full penetration welds and provide a flush and smooth transition between connecting ends. Grind all welds smooth. Weld ladder rails to bent-bar supporting brackets anchored to supporting structure as shown.

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

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

2.2.7 Lock Wall Armor

Fabricate lock wall armor tees and preformed corner protection plates from steel conforming to ASTM A36/A36M or ASTM A572/A572M. 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. Conform installation to details shown. Erect tees and preformed plates true to line and grade. The continuous edges of exposed faces must 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 must 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, install an extra anchor at the proper location to draw the section into position. Counter sink bolt heads on exposed faces and fit so that they are flush with the finished surfaces. Make joints between abutting sections square and saw or otherwise made smooth and regular the butting ends.

2.2.8 Lock Wall Line Hooks and Check Posts

Fabricate lock wall line hooks and check posts of alloy steel mechanical tubing as specified in paragraph MECHANICAL. Dimensions are as shown, including outside diameter and wall thickness, and anchor bars.

2.2.9 Guy Cables

Prestretched, galvanized wire rope of the sizes indicated. Conform wire rope to ASTM A475, high strength grade with Class A coating. Provide guys with a factory attached clevis top-end fitting and a factory attached open-bridge strand socket bottom-end fitting; complete with oval eye, threaded anchor rods. Hot-dip galvanize fittings and accessories.

2.2.10 Safety Chains

Galvanized welded steel, proof coil chain tested in accordance with ASTM A467/A467M, Class CS; 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 must be galvanized 10 mm 3/8 inch bolt with 19 mm 3/4 inch eye, anchored as indicated. Furnish two chains for each guarded opening.

2.2.11 Surface Finishes

2.2.11.1 Galvanizing and Zinc Repair

Hot-dip galvanize items specified to be galvanized, when practicable and not indicated otherwise, after fabrication. Galvanize in accordance with ASTM A123/A123M, ASTM A653/A653M, or ASTM A924/A924M, as applicable. Regalvanize areas where zinc coatings are destroyed by cutting, welding or other causes. Regalvanize coatings 50 g 2 ounces or heavier 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. Repair coatings less than 50 g 2 ounces in accordance with ASTM A780/A780M.

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 matte, AA DAF45. Unless otherwise specified, provide all other aluminum items with [standard mill finish.] [hand sanded or machine finish to a 240 grit.] [anodized finish.] Provide a coating thickness 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 DAF45. Items to be anodized receive a polished satin finish.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

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

3.2 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 anchors, 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.

3.3 FINISHES

3.3.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to SSPC Paint 20 or SSPC Paint 29 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 D1187/D1187M, asphalt-base emulsion.

3.3.2 Field Preparation

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

3.4 ATTACHMENT OF HANDRAILS

Set railing posts anchored to concrete surfaces perpendicular to the posts [in sleeve inserts anchored in the concrete, and fill the space between posts and sleeves with a sealant or a quick-setting hydraulic cement and cover with standard collar fittings secured to the posts. Drill a 6 mm 1/4 inch drain hole 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 must [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 must be [welded to base plates] [rigidly secured to flange fittings] [[bolted] [welded] to structural metal]. Rigidly secure ends of rails anchored to concrete or masonry to flange fittings anchored to concrete or masonry with expansion anchors. Install toeboards and brackets where indicated. Splice, where required, at expansion joints. Install removable sections as indicated.

3.4.1 Installation of Steel Handrails

Perform installation by means of pipe sleeves secured to [wood with screws.] [masonry with expansion anchors or toggle bolts.] [base plates bolted to stringers or structural steel framework.] Secure rail ends by steel pipe flanges [anchored by expansion anchors.] [through-bolted to a back plate or by 6 mm 1/4 inch lag bolts to studs or solid backing.]

3.4.2 Installation of Aluminum Handrails

Perform installation 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]. Provide stainless steel bolts used to anchor aluminum alloy flanges of a size appropriate to the standard product of the manufacturer. Provide neoprene washers and sleeves between dissimilar metals. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or portland cement concrete, give the contact surface a heavy coating of bituminous paint or asphalt varnish.

3.5 MOUNTING OF SAFETY CHAINS

Mount safety chains 1 m 3 feet 6 inches and 600 mm 2 feet above the floor.

3.6 COVER PLATES AND FRAMES

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

3.7 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 anchors.] 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 rest ends of ladders rest upon [finished roof] [floor].

3.8 STEEL STAIRS

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

3.9 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

****

NOTE: Ensure details of pipe guard installation are shown on the drawings.

****

Set pipe guards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete [specified in Section 03 30 00 CAST-IN-PLACE CONCRETE] [having a compressive strength of 21 MPa 3000 psi].

-- End of Section --