Preparing Activity: NASA Superseding
UFGS-05 52 00 (February 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 05 52 00

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08/23

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USACE / NAVFAC / AFCEC / NASA **UFGS-05 52 00 (August 2023)**

Preparing Activity: NASA **Superseding**
UFGS-05 52 00 (February 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

****

SECTION 05 52 00

METAL RAILINGS
08/23

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NOTE: This guide specification covers the requirements for metal railing systems which are not a part of any other metals system of the specification.

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).

****

PART 1 GENERAL

****

NOTE: Associated work found in Division 05, "Metals," includes:

Structural welding

Structural steel

Miscellaneous metal frabrications

Steel stairs

Metal ladders

Decorative metal specialties

Installation of inserts and anchorage devices

****

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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 180	(2012; R 2017) Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail
AASHTO M 314	(1990; R 2013) Standard Specification for Steel Anchor Bolts

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts

	and Screws (Inch Series)
ASME B18.2.3.8M	(1981; R 2005) Metric Hex Lag Screws
ASME B18.6.1	(2016) Wood Screws (Inch Series)
ASME B18.6.3	(2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)
ASME B18.6.5M	(2000; R 2010) Standard Specification for Metric Thread-Forming and Thread-Cutting Tapping Screws
ASME B18.6.7M	(1999; R 2010) Metric Machine Screws
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

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	(2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel

	Plates
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325M	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A449	(2014; R 2020) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A467/A467M	(2020) Standard Specification for Machine Coil Chain
ASTM A500/A500M	(2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A512	(2006; R 2012) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A575	(2020) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C514	(2004; R 2020) Standard Specification for Nails for the Application of Gypsum Board
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E488/E488M	(2022) Standard Test Methods for Strength of Anchors in Concrete Elements
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

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 898-1 (2013) Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel – Part 1: Bolts, Screws and Studs with Specified Property Classes – Coarse Thread and Fine Pitch Thread

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521 (2001; R 2012) Pipe Railing Systems Manual

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Preinstallation Meetings

Within [30] [_____] days of contract award, submit fabrication drawings [to the Contracting Officer] for the following items:

[a. Iron and steel hardware

][b. Steel shapes, plates, bars and strips

][c. Steel railings and handrails

][d. Aluminum railings and handrails

] e. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

[a. Structural-steel plates, shapes, and bars

][b. Structural-steel tubing

][c. Cold-finished steel bars

][d. Hot-rolled carbon steel bars

][e. Cold-drawn steel tubing

][f. Concrete inserts

][g. Masonry anchorage devices

][h. Protective coating

][i. Steel railings and handrails

][j. Aluminum railings and handrails

] k. Anchorage and fastening systems

1.3 SUBMITTALS

****

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.

****

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

Fabrication Drawings; G[, [____]]

Iron and Steel Hardware; G[, [____]]

Steel Shapes, Plates, Bars and Strips; G[, [____]]

SD-03 Product Data

Concrete Inserts; G[, [____]]

Masonry Anchorage Devices; G[, [____]]

Protective Coating; G[, [____]]

Steel Railings and Handrails; G[, [____]]

Aluminum Railings and Handrails; G[, [____]]

Anchorage and Fastening Systems; G[, [____]]

SD-05 Design Data

Design Calculations For Steel Connections; G

SD-06 Test Reports

Welding Inspections; G

Mill Test Reports; G

SD-07 Certificates

Welder Qualification; G[, [____]]

SD-08 Manufacturer's Instructions

Installation Instructions

1.4 QUALITY CONTROL

1.4.1 Welding Procedures

****
NOTE: If Section 05 05 23.16 STRUCTURAL WELDING is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.
****

[Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

] Submit results of welding inspections testing in accordance with AWS D1.1/D1.1M by an approved testing laboratory at the Contractor's expense. Provide laboratory welding inspection results to Contracting Officer.

1.4.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, conduct an immediate retest of two test welds and ensure that each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

1.5 QUALITY ASSURANCE

1.5.1 Fabrication Drawing Requirements

****

NOTE: Include the requirement for fabrication drawings to be signed and sealed when delegated design is performed by the contractor.

****

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 325, AISC 326, ASCE 7-22, and State of [ ] Building Code. Fabrication drawings will not be reproductions of contract drawings.[Sign and seal fabrication drawings by a registered professional engineer.] Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Clearly highlight any deviations from the details shown on the contract drawings highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

[1.5.2 Delegated Connection Design

****

NOTE: Include this paragraph when delegated design is performed by the contractor.

Provide connection loads on the drawings and indicate whether the loads are LRFD, ASD, or Combined.

****

Design structural steel connection indicated in the contract documents per AISC 360. Submit design calculations for steel connections signed and sealed by a registered professional engineer.

]

PART 2 PRODUCTS

2.1 FABRICATION

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning, treating, and applying surface finishes, including zinc coatings.

Provide railing and handrail detail plans and elevations at not less than 1 to 12 scale 1 inch to 1 foot. Provide details of sections and connections at not less than 1 to 4 scale 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of

the size and thickness necessary to produce adequate strength and durability in the finished product for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and straight sharp edges. Ensure that all exposed edges are eased to a radius of approximately 0.8 millimeter 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form the exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use countersunk Phillips flathead screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.1.1 Aluminum Railings

Fabrication: Provide fabrication jointing by one of the following methods:

a. Use flush-type rail fittings, welded and ground smooth with splice locks secured with 10 mm 3/8 inch recessed-head set screws.

b. Ensure that mitered and welded joints made by fitting; post to top rail; intermediate rail to post; and corners, are groove welded and ground smooth. Where allowed by the Contracting Officer, provide butt splices reinforced by a tight-fitting dowel or sleeve not less than 150 mm 6 inches in length. Tack-weld or epoxy-cement the dowel or sleeve to one side of the splice.

c. Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 6 or 10 mm 1/4 or 3/8 inch stainless-steel recessed-head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B26/B26M.

[Provide removable railing sections as indicated. [Provide toe-boards and brackets where indicated, using flange castings as appropriate.]

]2.1.2 Steel Handrails

Fabricate joint posts, rail, and corners by one of the following methods:

a. Flush-type rail fittings of commercial standard, welded and ground smooth, with railing splice locks secured with 10 mm 3/8 inch hexagonal-recessed-head setscrews.

b. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove-welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight-fitting interior sleeve not less than 150 mm 6 inches long.

c. Railings may be bent at corners in lieu of jointing, provided that bends are made in suitable jigs and the pipe is not crushed.

[Provide removable sections as indicated.

][2.1.3 Protective Coating

[Shop-prime the steelwork as indicated in accordance with Section 09 90 00 PAINTS AND COATINGS except the following:

a. Steel surfaces encased in concrete

b. Steel surfaces for welding

c. High-strength bolt-connected contact surfaces

d. Crane rail surfaces

][Provide hot-dipped galvanized steelwork as indicated in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

]]2.2 COMPONENTS

[2.2.1 Structural Steel Plates, Shapes and Bars

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A36/A36M, unless otherwise noted.

Provide steel plates, to be bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Provide steel bars and bar-size shapes conforming to ASTM A36/A36M, unless otherwise noted.

][2.2.2 Structural-Steel Tubing

****

NOTE: Includes square, rectangular, round, and specially shaped structural-steel tubing.

****

Provide structural-steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

][2.2.3 Hot-Rolled Carbon Steel Bars

Provide bars and bar-size shapes conforming to ASTM A575, grade as selected by the fabricator.

][2.2.4 Cold-Finished Steel Bars

Provide cold-finished steel bars conforming to ASTM A108, grade as selected by the fabricator.

][2.2.5 Cold-Drawn Steel Tubing

Provide tubing conforming to ASTM A512, sunk-drawn, butt-welded, cold-finished, and stress-relieved.

][2.2.6 Steel Pipe

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

][2.2.7 Concrete Inserts

****
NOTE: Use inserts for fastening steel stair items to cast-in-place concrete construction subjected to direct pullout loadings such as shelf angles and supports attached to concrete slab ceilings. Indicate all locations of inserts.
****

[Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive M20 3/4 inch diameter machine bolts; either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M, hot-dip galvanized in accordance with ASTM A153/A153M.

][Provide wedge-type concrete inserts consisting of galvanized box-type ferrous castings designed to accept M20 3/4 inch diameter bolts having special wedge-shaped heads, made of either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M and hot-dip galvanized in accordance with ASTM A153/A153M.

][Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with ASTM A153/A153M. Provide slotted-type concrete inserts consisting of a galvanized 3 millimeter 1/8 inch thick pressed-steel plate conforming to ASTM A283/A283M, made of box-type welded construction with a slot designed to receive M20 3/4 inch diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with ASTM A123/A123M.

]][2.2.8 Masonry Anchorage Devices

****
NOTE: Use masonry anchorage devices only for fastening steel stair items to solid masonry and concrete when the anchor is not subjected to pullout loads or vibration in shear loads.
****

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

[Provide lead expansion shields for machine screws and bolts 6 millimeter 1/4 inch and smaller; head-out embedded nut type, single-unit class, Group I, Type 1, Class 1.

][Provide lead expansion shields for machine screws and bolts larger than 6 millimeter 1/4 inch in size; head-out embedded nut type, multiple-unit class, Group I, Type 1, Class 2.

][Provide bolt anchor expansion shields for lag bolts; zinc-alloy, long-shield anchor class, Group II, Type 1, Class 1.

][Provide bolt anchor expansion shields for bolts; closed-end bottom-bearing class, Group II, Type 2, Class 1.
]

****
NOTE: Use toggle bolts for anchoring steel stair items to hollow masonry and stud partitions.
****

[Provide tumble-wing-type toggle bolts conforming to ASTM A325M ASTM F3125/F3125M, ASTM A449 and ASTM C636/C636M, type, class, and style as required.
]
][2.2.9 Fasteners

Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

[Provide standard hexagon-head bolts, conforming to ISO 898-1 ASTM A307, Grade A.

][Provide square-head lag bolts conforming to ASME B18.2.3.8M ASME B18.2.1.

][Provide cadmium-plated steel machine screws conforming to ASME B18.6.7M ASME B18.6.3.

][Provide flat-head carbon steel wood screws conforming to ASME B18.6.5M ASME B18.6.1.

][Provide plain round, general-assembly-grade, carbon steel washers conforming to ASME B18.22M ASME B18.21.1.

][Provide helical spring, carbon steel lockwashers conforming to ASME B18.2.3.8M ASME B18.2.1.

]][2.2.10 Steel Railings And Handrails

****
NOTE: Ensure that handrail design meets loads of the applicable building code, OSHA, and ADA. Decorative architectural handrail is not covered in this section. See NAAMM, "Pipe Railing Manual" for suggestions.
****

****
NOTE: Design grab bars, shower seats, and dressing

room bench seat systems to resist a single concentrated load of 250 pounds (1.11 kN) applied in any direction at any point.
****

Design handrails to resist a concentrated load of[890 N][200 lb] [_____] in any direction at any point of the top of the rail or[730 N/m][50 lb per foot] [_____] applied horizontally to the top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts. [Provide series 300 stainless-steel pipe collars.]

2.2.10.1 Steel Handrails

****
NOTE: ASTM A53 pipe at the 30 mm 1 1/4 inch nominal diameter meets the minimum requirements since the outside diameter is 45 mm 1.66 inches.
****

Provide steel handrails, including inserts in concrete, [steel pipe conforming to ASTM A53/A53M] [or] [structural tubing conforming to ASTM A500/A500M, Grade A or B of equivalent strength]. Provide steel railings of [40] [50] mm [1 1/2] [2] inch nominal size,[hot-dip galvanized] [and] [shop-painted].

Provide kickplates between railing posts where indicated, and consisting of 4 millimeter 1/8 inch steel flat bars not less than 150 millimeter 6 inches high. Secure kickplates as indicated.

[Galvanize exterior railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Provide black steel pipe for interior railings.

][Provide galvanized exterior and interior railings where indicated, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Provide black steel pipe for interior railings not indicated as galvanized.

][Provide galvanized railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components.

]][2.2.11 Aluminum Railings And Handrails

****
NOTE: Do not use slip-on fittings and set screws for locations subject to abusive use by building occupants. The less expensive Alloy 6061-T6 meets the strength requirements, but is not suitable for bending, and discolors when anodized. Handrail fastenings should be of Series 300 stainless steel. Specify No. 316 for marine environments.
****

Provide railings and handrails consisting of[[40] [50] mm [1 1/2] [2] inch nominal schedule 40 pipe ASTM B429/B429M],[45 mm 1 3/4 inch square aluminum semihollow tube with rounded corners ASTM B221M ASTM B221]. Provide [mill-finish] [anodized] aluminum [[_____] color] railings. Ensure that all fasteners are Series 300 stainless steel.

]2.2.12 Safety Chains [And Guardrails]

Provide safety chains of galvanized steel, straight-link type, 5 mm 3/16 inch diameter, with at least 12 links per 300 mm foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide snap hooks of boat type. Provide galvanized 10 mm 3/8 inch bolt with 20 mm 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 100 mm 4 inches longer than the anchorage spacing, for each guarded area. [Provide corrugated sheet steel beam guardrail conforming to the requirements of AASHTO M 180, Type [_____] of the class specified on the drawings. Provide bolts and nuts as indicated, conforming to the requirements of ASTM A307.] Locate [guardrails] safety chain where indicated. Mount the top chain [rail] 1050 mm feet 6 inches [_____] above the [floor] [ground] and mount the lower chain [rail] 600 mm 2 feet [_____] above the [floor] [ground].

2.3 Mill Test Reports

Provide mill test reports for [structural steel plates, shapes, and bars][structural steel tubing][hot-rolled carbon steel bars][cold-drawn steel tubing]. Mill test report will include but is not limited to material heat number, material grade, edition year and type of specification met, material dimension, mechanical properties, chemical analysis, heat treatment (if applicable), and certified inspector signature.

PART 3 EXECUTION

3.1 PREPARATION

Adjust stair railings and handrails before securing in place in order to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than [2440 millimeter] [_____] [8 feet] [_____] on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

[a. Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard-weight, steel pipe, not less than 150 millimeter 6 inches long, and having an inside diameter not less than 13 millimeter 1/2 inch greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom of the sleeve, with closure width and length not less than 25 millimeter 1 inch greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, fill the annular space between the post and sleeve with nonshrink grout or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.

][b. Anchor posts to steel with oval steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

][c. Anchor rail ends into concrete and masonry with round steel flanges welded to rail ends and anchored into the wall construction with lead expansion shields and bolts.

][d. Anchor rail ends to steel with oval or round steel flanges welded to tail ends and bolted to the structural-steel members.

] Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends. Provide brackets of malleable iron castings, with not less than 75 millimeter 3 inch projection from the finished wall surface to the center of the pipe, drilled to receive one M10 3/8 inch bolt. Locate brackets not more than 1525 millimeter 60 inches on center. Provide wall return fittings of cast iron castings, flush type, with the same projection as that specified for wall brackets. Secure wall brackets and wall return fittings to building construction as follows:

[a. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

][b. For hollow masonry and stud partition anchorage, use toggle bolts having square heads.

] Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

3.2 INSTALLATION

Submit manufacturer's installation instructions for the following products to be used in the fabrication of [steel] [_____] [stair railing] [and] [hand rail work]:

[a. Structural-steel plates, shapes, and bars

][b. Structural-steel tubing

][c. Cold-finished steel bars

][d. Hot-rolled carbon steel bars

][e. Cold-drawn steel tubing

][f. Protective coating

][g. Masonry anchorage devices

][h. Steel railings and handrails

][i. Aluminum railings and handrails

][j. Anchorage and fastening systems

] Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars, and strips used in accordance with the design specifications cited in this section.

[3.2.1 Steel Handrail

Install handrail [in pipe sleeves embedded in concrete and filled with nonshrink grout or quick-setting anchoring cement with anchorage covered with standard pipe collar pinned to post.][by means of pipe sleeves secured to wood with screws.][by means of masonry with expansion shields and bolts or toggle bolts.][by means of base plates bolted to stringers or structural-steel frame work.] Secure rail ends 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.]

][3.2.2 Aluminum Handrail

Affix to base structure by [flanges anchored to concrete or other existing masonry by expansion shields] [base plates or flanges bolted to stringers or structural-steel framework] [flanges through-bolted to a backing plate on the other side of a wall] [flanges lag-bolted to studs or other structural timbers]. Provide Series 300 stainless-steel bolts to anchor aluminum alloy flanges, 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 concrete, coat the contact surface with a heavy coating of bituminous paint.

][3.2.3 Touchup Painting

****
NOTE: Delete the paragraph and heading if touchup painting is to be excluded from the steel stair erector's work.
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Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 0.051 millimeter 2 mils.

]3.3 FIELD QUALITY CONTROL

3.3.1 Field Welding

Ensure that procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with AWS D1.1/D1.1M.

-- End of Section --