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DIVISION 05 - METALS

SECTION 05 52 00

METAL RAILINGS

02/18

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-- End of Section Table of Contents --
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 steel
Miscellaneous metal
Steel stairs
Ornamental railings
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)


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 B18.6.7M (1999; R 2010) Metric Machine Screws
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
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
- Structural-Steel Plates, Shapes, and Bars; G[, [___]]
- Structural-Steel Tubing; G[, [___]]
- Cold-Finished Steel Bars; G[, [___]]
- Hot-Rolled Carbon Steel Bars; G[, [___]]
- Cold-Drawn Steel Tubing; G[, [___]]
- 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-07 Certificates
- Welding Procedures; G[, [___]]
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 procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

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.

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 / \(\frac{1}{32}\) 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 / \(\frac{3}{8}\) 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 / \(\frac{1}{4}\) or \(\frac{3}{8}\) 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 / \(\frac{3}{8}\) 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 \( \text{M20} \frac{3}{4} \text{ inch} \) 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 \( \text{M20} \frac{3}{4} \text{ inch} \) 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 \( 3 \text{ millimeter} \frac{1}{8} \text{ inch} \) thick pressed-steel plate conforming to ASTM A283/A283M, made of box-type welded construction with a slot designed to receive \( \text{M20} \frac{3}{4} \text{ inch} \) diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with ASTM A123/A123M.

2.2.8 Masonry Anchorage Devices

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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
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 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, \(5\,\text{mm}\) \(3/16\) inch diameter, with at least 12 links per \(300\,\text{mm}\) 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 \(10\,\text{mm}\) \(3/8\) inch bolt with \(20\,\text{mm}\) \(3/4\) inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, \(100\,\text{mm}\) \(4\) 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] \(1050\,\text{mm}\) \(6\) inches [_____] above the [floor] [ground] and mount the lower chain [rail] \(600\,\text{mm}\) \(2\) feet [_____] above the [floor] [ground].

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 \(2440\,\text{millimeter}\) [_____] \(8\) 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 \(150\,\text{millimeter}\) \(6\) inches long, and having an inside diameter not less than \(13\,\text{millimeter}\) \(1/2\) 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 \(25\,\text{millimeter}\) \(1\) 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 \(75\,\text{millimeter}\) \(3\) 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 \(1525\,\text{millimeter}\) \(60\) 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 framework] 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.
**************************************************************************

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 --