SECTION 05 52 00

METAL RAILINGS
02/18

PART 1 GENERAL

1.1 REFERENCES

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.

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

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS B 1048	(2007) Fasteners - Hot Dip Galvanized Coatings
JIS B 1111	(2017) Cross Recessed Machine Screws
JIS B 1112	(2019) Cross-Recessed Head Wood Screws
JIS B 1189	(2014) Hexagon Bolt with Flange
JIS B 1251	(2018) Spring Lock Washers
JIS B 1256	(2008) Plain Washers
JIS F 2106	(2013) General Chain for Ships
JIS G 3101	(2020) Rolled Steels for General Structure
JIS G 3138	(2021) Rolled Steel Bars for Building Structure
JIS G 3444	(2021) Carbon Steel Tubes for General Structure
JIS G 3459	(2017) Stainless Steel Pipes (Amendment 1)
JIS G 3466	(2021) Carbon Steel Square and Rectangular Tubes for General Structure
JIS G 3475	(2021) Carbon Steel Tubes for Building Structure
JIS G 4051	(2018) Carbon Steels for Machine Structural Use (Amendment 1)
JIS G 4304	(2021) Hot-Rolled Stainless Steel Plate,

	Sheet and Strip
JIS G 4305	(2015) Cold-Rolled Stainless Steel Plate, Sheet and Strip (Amendment 1)
JIS G 5101	(1991) Carbon Steel Castings
JIS G 5705	(2018) Malleable Iron Castings
JIS H 4040	(2015) Aluminum and Aluminum Alloy Bars and Wires
JIS H 4100	(2015) Aluminum and Aluminum Alloy Extru ded Profiles
JIS H 5202	(2010) Aluminum Alloy Castings
JIS H 8641	(2021) Hot Dip Galvanized Coatings
JIS Z 3410	(2013) Welding Coordination - Tasks and Responsibilities
JIS Z 3420	(2003) Specification and Approval of Welding Procedures for Metallic Materials - General Rules
JIS Z 3604	(2016) Inert Gas Arc Welding Standard for Aluminum
JIS Z 3801	(2018) Standard Qualification Test and Acceptance Requirements for Manual Welding Technique
JIS Z 3841	(2018) Standard Qualification Test and Acceptance Requirements for Semi-Automatic Welding Technique

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

MLIT Chapter 14	Metal Work

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. Stainless Steel railings and handrails

][e. Aluminum railings and handrails

] f. 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. Stainless Steel railings and handrails

][k. Aluminum railings and handrails

] l. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G[, [_____]]

Iron and Steel Hardware

Steel Shapes, Plates, Bars and Strips

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

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

] Submit results of welding procedures testing in accordance with JIS Z 3801 or JIS Z 3841 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 JIS Z 3801 or JIS Z 3841, 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 DESIGN

Design all handrails and guards to resist a concentrated load of[890 N][ ] [_____] in any direction at any point of the top of the rail or[730 N/m][ ] [_____] applied horizontally to the top of the rail, whichever is more severe. Intermediate rails, balusters and panel fillers shall be design to resist a concentrated load of[220 N][ ]. MLIT Chapter 14, 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.]

In addition to the above loads exterior railings shall be also designed to withstand a wind load of [ ]N/m.

2.2 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 10 scale. Provide details of sections and connections at not less than 1 to 5 scale. 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. 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 JIS Z 3420 and JIS Z 3604. 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.

2.2.1 Aluminum Railings and Handrails

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 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 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 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 JIS H 5202.

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

]2.2.2 Steel Railings and 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

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 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.

][2.2.3 Stainless Steel Railings and Handrails

Provide stainless steel tubing, welded or seamless, conforming to JIS G 4304, JIS G 4305 or JIS G 3459 unless otherwise noted.

][2.2.4 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 JIS H 8641. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

]]2.3 COMPONENTS

[2.3.1 Structural Steel Plates, Shapes And Bars

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to JIS G 3101, unless otherwise noted.

Provide steel plates, to be bent or cold-formed, conforming to JIS G 3101, SS 400.

Provide steel bars and bar-size shapes conforming to JIS G 3101, unless otherwise noted.

][2.3.2 Structural-Steel Tubing

Provide structural-steel tubing, hot-formed, welded or seamless, conforming to JIS G 3466 unless otherwise noted.

][2.3.3 Hot-Rolled Carbon Steel Bars

Provide bars and bar-size shapes conforming to JIS G 3138, grade as selected by the fabricator.

][2.3.4 Cold-Finished Steel Bars

Provide cold-finished steel bars conforming to JIS G 4051, grade as selected by the fabricator.

][2.3.5 Cold-Drawn Steel Tubing

Provide tubing conforming to JIS G 3444, sunk-drawn, butt-welded, cold-finished, and stress-relieved.

][2.3.6 Steel Pipe

Provide pipe conforming to JIS G 3466 STK 400 and 235 MPa or JIS G 3475, STKN400B and 235 MPa; primed finish, unless galvanizing is required; standard weight (Schedule 40).

][2.3.7 Concrete Inserts

[Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive M20 diameter machine bolts; either malleable iron conforming to JIS G 5705 or cast steel conforming to JIS G 5101, SC 42, SC 46 or SC 49, hot-dip galvanized in accordance with JIS B 1048.

][Provide wedge-type concrete inserts consisting of galvanized box-type ferrous castings designed to accept M20 diameter bolts having special wedge-shaped heads, made of either malleable iron conforming to JIS G 5705 or cast steel conforming to JIS G 5101 and hot-dip galvanized in accordance with JIS B 1048.

][Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with JIS B 1048. Provide slotted-type concrete inserts consisting of a galvanized 3 millimeter thick pressed-steel plate conforming to JIS G 3101 SS41 or SB35, made of box-type welded construction with a slot designed to receive M20 diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with JIS H 8641.

]][2.3.8 Fasteners

Provide galvanized zinc-coated fasteners in accordance with JIS B 1048 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.

][Provide square-head lag bolts conforming to JIS B 1189.

][Provide cadmium-plated steel machine screws conforming to JIS B 1111.

][Provide flat-head carbon steel wood screws conforming to JIS B 1112.

][Provide plain round, general-assembly-grade, carbon steel washers conforming toJIS B 1256.

][Provide helical spring, carbon steel lockwashers conforming to JIS B 1251.

]][2.3.9 Steel Railings and Handrails

2.3.9.1 Steel Handrails

Provide steel handrails, including inserts in concrete, [steel pipe conforming to JIS G 3466] [or] [structural tubing conforming to JIS G 3466]. Provide steel railings of [40] [50] mm nominal size,[hot-dip galvanized] [and] [shop-painted].

Provide kickplates between railing posts where indicated and consisting of 4 millimeter steel flat bars not less than 150 millimeter 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.

]][2.3.10 Aluminum Railings and Handrails

Provide railings and handrails consisting of[[40] [50] mm nominal schedule 40 pipe JIS H 4100], 45 mm aluminum semi hollow tube with rounded corners JIS H 4040. Provide [mill-finish] [anodized] aluminum [_____] color railings. Ensure that all fasteners are Series 300 stainless steel.

]2.3.11 Safety Chains [and Guardrails]

Provide safety chains of galvanized steel, straight-link type, 5 mm diameter, with at least 12 links per 300 mm, and with snap hooks on each end. Test safety chain in accordance with JIS F 2106. Provide snap hooks of boat type. Provide galvanized 10 mm bolt with 20 mm eye diameter for attachment of chain, anchored as indicated. Supply two chains, 100 mm longer than the anchorage spacing, for each guarded area. Locate [guardrails] safety chain where indicated. Mount the top chain [rail] 1050 mm [_____] above the [floor] [ground] and mount the lower chain [rail] 600 mm [_____] 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 millimeter] [_____] 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 long, and having an inside diameter not less than 13 millimeter 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 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 non-shrink 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 projection from the finished wall surface to the center of the pipe, drilled to receive one M10 bolt. Locate brackets not more than 1525 millimeter 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 non-shrink 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 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

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.

]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 JIS Z 3410, JIS Z 3420, or JIS Z 3604.

-- End of Section --