
USACE / NAVFAC / AFCEA / NASA UFGS-05 52 00 (April 2008)

Preparing Activity: NASA New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2008

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 52 00

METAL RAILINGS

04/08

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALIFICATIONS FOR WELDING WORK

PART 2 PRODUCTS

- 2.1 GENERAL REQUIREMENTS
- 2.2 STRUCTURAL STEEL PLATES, SHAPES AND BARS
- 2.3 STRUCTURAL STEEL TUBING
- 2.4 HOT-ROLLED CARBON STEEL BARS
- 2.5 COLD-FINISHED STEEL BARS
- 2.6 COLD-DRAWN STEEL TUBING
- 2.7 STEEL PIPE
- 2.8 CONCRETE INSERTS
- 2.9 MASONRY ANCHORAGE DEVICES
- 2.10 FASTENERS
- 2.11 GENERAL FABRICATION
- 2.12 PROTECTIVE COATING
- 2.13 STEEL RAILINGS AND HANDRAILS
 - 2.13.1 Steel Handrails
- 2.14 ALUMINUM RAILINGS AND HANDRAILS
- 2.15 SAFETY CHAINS [AND GUARDRAILS]

PART 3 EXECUTION

- 3.1 STAIR RAILINGS AND HANDRAILS
- 3.2 STEEL HANDRAIL
- 3.3 ALUMINUM HANDRAIL
- 3.4 FIELD WELDING
- 3.5 TOUCHUP PAINTING

-- End of Section Table of Contents --

USACE / NAVFAC / AFCEA / NASA UFGS-05 52 00 (April 2008)

Preparing Activity: NASA New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2008

SECTION 05 52 00

METAL RAILINGS 04/08

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

Associated work found in Division 5, "Metals," includes:

Structural steel

Miscellaneous metal

Steel Stairs

Ornamental railings

Installation of inserts and anchorage devices

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

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

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the

publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 180 (2000; R 2004) Corrugated Sheet Steel
Beams for Highway Guardrail

AASHTO M 314 (1990; R 2004) Standard Specification for
Steel Anchor Bolts

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121 (2004) Standard Definitions for Use in the
Design of Steel Structures

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

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

ANSI B18.22M (1981; R 2005) Metric Plain Washers

AMERICAN WELDING SOCIETY (AWS)

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

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (1996; Addenda A 1999; Errata 2003; R
2005) Square and Hex Bolts and Screws
(Inch Series)

ASME B18.2.3.8M (1981; R 2005) Metric Hex Lag Screws

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

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

Nuts

ASME B18.6.7M

(1999; R 2005) Metric Machine Screws

ASTM INTERNATIONAL (ASTM)

ASTM A 108

(2007) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A 123/A 123M

(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M

(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 27/A 27M

(2005) Standard Specification for Steel Castings, Carbon, for General Application

ASTM A 283/A 283M

(2003; R 2007) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A 307

(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 325

(2007a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 325M

(2007) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)

ASTM A 36/A 36M

(2005) Standard Specification for Carbon Structural Steel

ASTM A 449

(2007b) Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

ASTM A 467/A 467M

(2007) Standard Specification for Machine Coil and Chain

ASTM A 47/A 47M

(1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A 500/A 500M

(2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 512

(2006) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing

ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 575	(1996; R 2007) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(2007) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 26/B 26M	(2005) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 429/B 429M	(2006) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 514	(2004) Standard Specification for Nails for the Application of Gypsum Board
ASTM C 636/C 636M	(2006) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F 568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

INDUSTRIAL FASTENERS INSTITUTE (IFI)

IFI 502	(1982) Metric Tapping Screws
---------	------------------------------

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	(2001) Pipe Railing Manual
---------------	----------------------------

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; E 2004) Paint Specification No. 25Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II
---------------	---

1.2 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit

the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation 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

Submit fabrication drawings for the following items in accordance with the paragraph entitled, "General Requirements," of this section.

Iron and Steel Hardware
Steel Shapes, Plates, Bars and Strips
Steel Railings and Handrails
Aluminum Railings and Handrails

SD-03 Product Data

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

Structural Steel Plates, Shapes, and Bars
Structural Steel Tubing
Cold Finished Steel Bars
Hot-Rolled Carbon Steel Bars

Cold-Drawn Steel Tubing
Concrete Inserts
Masonry Anchorage Devices
Protective Coating
Steel Railings and Handrails
Aluminum Railings and Handrails

SD-07 Certificates

Submit [Welding Procedures](#) in accordance with [AWS D1.1/D1.1M](#).

Submit certificates for [Welder Qualification](#) in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

SD-08 Manufacturer's Instructions

Submit manufacturer's installation instructions for the following products to be used in the fabrication of steel stair work.

Structural Steel Plates, Shapes, and Bars
Structural Steel Tubing
Cold Finished Steel Bars
Hot-Rolled Carbon Steel Bars
Cold-Drawn Steel Tubing
Protective Coating
Masonry Anchorage Devices
Steel Railings and Handrails
Aluminum Railings and Handrails

1.3 QUALIFICATIONS FOR WELDING WORK

NOTE: If Section 05 05 23 WELDING, STRUCTURAL is
not included in the project specification,
applicable requirements therefrom should be inserted
and the following paragraph deleted.

[Section 05 05 23 WELDING, STRUCTURAL applies to work specified in this section.]

[Provide [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.

Provide certified [Welder Qualification](#) by tests in accordance with [AWS D1.1/D1.1M](#), or under an equivalent approved qualification test. In addition be performed on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, make an immediate retest of two test welds and each test weld must pass. 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 GENERAL REQUIREMENTS

Provide complete and detailed fabrication drawings for all [Iron and Steel Hardware](#), and for all [Steel Shapes, Plates, Bars and Strips](#) used in accordance with the design specifications referenced in this section.

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, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

2.2 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Structural-size shapes and plates, except plates to be bent or cold-formed, must conform to [ASTM A 36/A 36M](#), unless otherwise noted.

Steel plates to be bent or cold-formed must conform to [ASTM A 283/A 283M](#), Grade C.

Steel bars and bar-size shapes must conform to [ASTM A 36/A 36M](#), unless otherwise noted.

2.3 STRUCTURAL STEEL TUBING

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

Structural steel tubing, hot-formed, welded or seamless, must conform to [ASTM A 500/A 500M](#), Grade B, unless otherwise noted.

2.4 HOT-ROLLED CARBON STEEL BARS

Bars and bar-size shapes must conform to [ASTM A 575](#), grade as selected by the fabricator.

2.5 COLD-FINISHED STEEL BARS

Bars must conform to [ASTM A 108](#), grade as selected by the fabricator.

2.6 COLD-DRAWN STEEL TUBING

Tubing must conform to [ASTM A 512](#), sunk drawn, butt-welded, cold-finished, and stress-relieved.

2.7 STEEL PIPE

Pipe must conform to [ASTM A 53/A 53M](#), type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.8 CONCRETE INSERTS

NOTE: Inserts must be used 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. Locations of inserts must be indicated.

[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 A 47/A 47M or cast steel conforming to ASTM A 27/A 27M, hot-dip galvanized in accordance with ASTM A 153/A 153M.]

[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; they shall be either malleable iron conforming to ASTM A 47/A 47M or cast steel conforming to ASTM A 27/A 27M and hot-dip galvanized in accordance with ASTM A 153/A 153M.]

[Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with ASTM A 153/A 153M. Provide slotted-type concrete inserts consisting of galvanized 3 millimeter 1/8-inch thick pressed steel plate conforming to ASTM A 283/A 283M; they must be of box-type welded construction with slot designed to receive M20 3/4-inch diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with ASTM A 123/A 123M.]

2.9 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 E 488 and ASTM C 514 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 anchors 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: Toggle bolts must be used for anchoring steel stair items to hollow masonry and stud partitions.

Provide tumble-wing type toggle bolts conforming to ASTM A 325M ASTM A 325, ASTM A 449 and ASTM C 636/C 636M, type, class, and style as required.

2.10 FASTENERS

Galvanize zinc-coated fasteners in accordance with ASTM A 153/A 153M and 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.

Standard bolts and nuts must be regular hexagon-head conforming to ASTM F 568M ASTM A 307, Grade A.

Lag bolts must be square-head conforming to ASME B18.2.3.8M ASME B18.2.1.

Machine screws cadmium-plated steel conforming to ASME B18.6.7M ASME B18.6.3.

Wood screws must be flat-head carbon steel conforming to IFI 502 ASME B18.6.1.

Plain washers must be round, general-assembly-grade, carbon steel conforming to ANSI B18.22M ANSI B18.22.1.

Lockwashers must be helical spring, carbon steel conforming to ASME B18.2.3.8M ASME B18.2.1.

2.11 GENERAL FABRICATION

Provide Railings and Handrails 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 required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use 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. Exposed edges must be 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. Grid exposed welds smooth and flush to match and blend with adjoining surfaces.

Form 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 Phillips flathead (countersunk) 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.

2.12 PROTECTIVE COATING

[Shop prime steelwork with red oxide primer in accordance with SSPC Paint 25.]

[Shop prime steelwork as indicated in accordance with [AISC/AISI 121] [Section 09 97 13.00 40 STEEL COATINGS] except surfaces of steel to be encased in concrete, surfaces to be welded, contact surfaces to be high-strength bolt connected, and surfaces of crane rails.]

[Provide hot dipped galvanized steelwork as indicated in accordance with ASTM A 123/A 123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.]

2.13 STEEL RAILINGS AND HANDRAILS

NOTE: Handrail design must meet 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.

Design handrails to resist a concentrated load of [490 N] [250 lbs] [_____] in any direction at any point of the top of the rail or [290 N/m] [20 lbs per foot] [_____] applied horizontally to 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.]

2.13.1 Steel Handrails

NOTE: Standard A 53 pipe at nominal diameter 30 mm 1 1/4 inches 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 A 53/A 53M] [or] [structural tubing conforming to ASTM A 500/A 500M, Grade A or B of equivalent strength]. Provide steel railings of [40] [50] mm [1 1/2] [2] inches nominal size. [Railings to be hot-dip galvanized] [and] [shop painted].

- a. Fabrication: Joint posts, rail, and corners by one of the following methods:

- (1) 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.

(2) 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.

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

[b. Provide removable sections as indicated.]

Provide kickplates between railing posts where indicated, and consist 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.]

2.14 ALUMINUM RAILINGS AND HANDRAILS

NOTE: Do not use slip-on type 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.

Consists of [[40] [50] mm [1 1/2] [2] inch nominal schedule 40 pipe ASTM B 429/B 429M], [45 mm 1 3/4 inch square aluminum semi-hollow tube with rounded corners ASTM B 221M ASTM B 221]. Railings to be [mill finish] [anodized] aluminum [[_____] color]. All fasteners must be Series 300 stainless steel.

a. Fabrication: Provide jointing by one of the following methods:

(1) Flush-type rail fittings, welded and ground smooth with splice locks secured with 10 mm 3/8 inch recessed head set screws.

(2) Mitered and welded joints made by fitting post to top rail, intermediate rail to post, and corners, must be groove welded and ground smooth. Provide butted splices, where allowed by the Contracting Officer, and reinforced by a tight fitting dowel or sleeve not less than 150 mm 6 inches in length. Tack weld or epoxy cement dowel or sleeve to one side of the splice.

(3) 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 B 26/B 26M.

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

2.15 SAFETY CHAINS [AND GUARDRAILS]

Construct safety chains of galvanized steel, straight link type, 5 mm 3/16 inch diameter, with at least twelve links per 300 mm foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A 467/A 467M, 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. [Corrugated sheet steel beam guardrail to conform to the requirements of AASHTO M 180, Type [_____] of the class specified on the drawings. Provide bolts and nuts as indicated, and to conform to the requirements of ASTM A 307.] Locate [guard rails] 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].

PART 3 EXECUTION

3.1 STAIR RAILINGS AND HANDRAILS

Adjust railings prior to securing in place 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:

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 sleeved; closure must be of 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, the annular space between post and sleeve must be filled with molten lead, sulfur, or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.

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

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

Anchor rail ends to steel with steel oval or round 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 finish 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:

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

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

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

3.2 STEEL HANDRAIL

Install [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.] [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.]

3.3 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 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, give the contact surface a heavy coating of bituminous paint.

3.4 FIELD WELDING

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

3.5 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, and

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.

-- End of Section --