

SECTION 05 50 00

METAL FABRICATIONS

PART 1 – GENERAL

1.1 PURPOSE

- A. This guideline is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. PSP is to apply the principles of this section such that the University of Texas at Arlington (UTA) may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be approved by UTA and may require justification through Life Cycle Cost (LCC) analysis and submitted to UTA for approval.

1.2 LESSONS LEARNED AND DESIGN CONSIDERATIONS

- A. **Paint all cuts and welds to prevent rusting.**

1.3 SUMMARY

- A. This section includes the following metal fabrications:
 - 1. Rough hardware
 - 2. Ladders
 - 3. Ladder safety cages
 - 4. Miscellaneous framing, supports and trim
 - 5. Metal bar gratings
 - 6. Steel pipe guardrails and handrails
 - 7. Metal stairs
 - 8. Pipe bollards
- B. Related Sections: Refer to Section 05 12 00, "Structural Steel" for structural steel framing components as applicable.

1.4 REFERENCES

- A. Aluminum Association (AA)
- B. American National Standards Institute (ANSI)
 - 1. A14.3 - Safety Requirements for Fixed Ladders; current edition.
- C. American Society of Testing and Materials (ASTM)
- D. American Welding Society (AWS)
 - 1. D1.1 - Structural Welding Code - Steel; current edition.
 - 2. D1.3 - Structural Welding Code - Sheet Steel; current edition.
- E. National Association of Architectural Metal Manufacturers (NAAMM)
 - 1. AMP 500 Metal Finishes Manual; current edition.
 - 2. AMP 510 Metal Stair Manual; current edition.
 - 3. MBG 531 Metal Bar Grating Manual; current edition.
 - 4. MBG 532 Heavy Duty Metal Bar Grating Manual and Pipe Railing Manual; current edition.
- F. Steel Structures Painting Council (SSPC)

1.5 DEFINITIONS

- A. Refer to ASTM E985 for railing-related terms that apply to this section.
- B. Refer to the NAAMM publications listed in Article 1.02 "References" for definition of terms that apply to this section.

1.6 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01.
- B. Product Data: Submit product data for products used in metal fabrications, including paint products, grout and fasteners.
- C. Shop Drawings: Submit detailed shop and erection drawings of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Welder certificates signed by the Contractor certify that welders comply with requirements specified in

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- 1.05C.
- E. Welding Procedures: Provide written welding procedure specification (WPS) document per AWS Code requirements.
 - F. Qualification data for firm specified in 1.05B to demonstrate their capabilities and experience.
- 1.7 QUALITY ASSURANCE
- A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated. Where conflicts occur, comply with the more stringent requirements.
 - 1. ANSI 14.3
 - 2. AWS D1.1 and D1.3
 - 3. NFPA 101
 - B. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that shown on the drawings, with sufficient production capacity to produce required units without causing delay in the work.
 - C. Qualify welding processes and welding operators in accordance with AWS D1.1 and D1.3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 - D. All materials used shall be free of lead and asbestos fibers.

PART 2 – PRODUCTS

2.1 FERROUS METALS

- A. Metal Surfaces, General: Form metal fabrications exposed to view upon completion of the work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by referenced standards for stretcher- leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A36.
- C. Rolled Steel Floor Plates: ASTM A786.
- D. Steel Bars for Gratings: ASTM A569 or ASTM A36.
- E. Wire Rod for Grating Cross Bars: ASTM A510.
- F. Steel Tubing: Cold-formed, ASTM A500, Grade B, unless otherwise indicated.
- G. Uncoated Structural Steel Sheet: Hot-rolled, ASTM A570, Grade 30 unless otherwise indicated.
- H. Uncoated Steel Sheet (Commercial quality): Cold-rolled, ASTM A366.
- I. Galvanized Steel Sheet: Quality as follows:
 - 1. Structural Quality: ASTM A446; Grade A, unless another grade required for design loading, and G90 coating designation unless otherwise indicated.
 - 2. Commercial Quality: ASTM A526, G90 coating designation unless otherwise indicated.
- J. Steel Pipe: ASTM A53, Type S, Grade B, standard weight (schedule 40), black finish, unless otherwise indicated.
- K. Gray Iron Castings: ASTM A48, Class 30.
- L. Malleable Iron Castings: ASTM A47, Grade 32510.
- M. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- N. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A153.
- O. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

2.2 STAINLESS STEEL

- A. Bar Stock: ASTM A276, Type 302 or 304.
- B. Plate: ASTM A167, Type 302 or 304.

2.3 ALUMINUM

- A. Extruded Bars and Shapes: ASTM B221, alloy 6061-T6 or 6063-T6 for bearing bars of gratings and shapes and 6061-T6 for grating cross bars.
- B. Aluminum-Alloy Rolled Tread Plate: ASTM B632, alloy 6061-T4 for treads and 6061-T6 for platforms.

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2.4 GROUT

- A. Non-shrink Nonmetallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to the following:
 - 1. Euco N-S Grout - Euclid Chemical Co.
 - 2. Kemset - Chem-Masters Corp.
 - 3. Crystex - L & M Construction Chemicals, Inc.
 - 4. SonogROUT - Sonneborn Building Products Div., Rexnord Chemical Products, Inc.

2.5 FASTENERS

- A. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required. Suspect/counterfeit bolts will not be accepted and will be replaced at Contractor's expense.

2.6 PAINT

- A. Shop Primer for Ferrous Metal: Red oxide, lead- and cadmium-free, corrosion- inhibiting primer complying with performance requirements of FS TT-P-664.
- B. Galvanizing Repair Paint: High zinc dust content paint for galvanizing welds in galvanized steel, with dry film containing not less than 94% zinc dust by weight, and complying with SSPC-Paint-20.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint-12 except containing no asbestos fibers.
- D. Zinc Chromate Primer: FS TT-P-645.

2.7 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements for Section 03 30 00, "Cast-in-Place Concrete" for normal weight, ready-mix concrete with minimum 28- day compressive strength of 3000 psi (21 MPa), unless higher strength indicated.
- B. Nonslip Aggregate Finish: Factory-graded, packaged material containing fused aluminum oxide grits or crushed emery as abrasive aggregate; rust-proof and non- glazing; unaffected by freezing, moisture, or cleaning materials.

2.8 FABRICATION - GENERAL

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

Temperature change (Range): 100 ° F (38 ° C).

- C. Shear and punch metals cleanly and accurately. Remove burrs.
- D. Ease exposed edges to a radius of approximately 1/32" (0.794 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Remove sharp or rough areas on exposed traffic surfaces.
- F. Weld corners and seams continuously to comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matched those adjacent.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible.

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Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

- H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- I. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- J. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- K. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.9 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required. Fabricate items to sizes, shapes, and dimensions required.

2.10 STEEL LADDERS

- A. General: Exterior fixed ladders shall meet OSHA requirements found in 29CFR1910.27, with the exception that #6 rebar is not to be used. Fabricate ladders for the locations shown, with dimensions, spacing's, details and anchorages as indicated. Comply with requirements of ANSI A14.3 where conflicts occur, comply with the more stringent requirements.
- B. Side Rails: Continuous steel flat bars, minimum size (cross section) 2½" x ⅜" (63.5 mm x 9.5 mm), with eased edges, spaced 18" (0.46 m) apart.
- C. Bar Rungs: Round steel bars, minimum ¾" (19.1 mm) diameter spaced no greater than 12" (305 mm) o.c. and uniform throughout the length of the ladder. Individual metal rungs embedded in concrete which serve as access to pits and other areas under floors, should have a minimum diameter of 1" (25 mm) or shall otherwise be treated to resist corrosion and rusting.
- D. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
- E. Support each ladder at top and bottom and at intermediate points spaced not more than 5'-0" (1.5 m) o.c. by means of welded brackets, unless otherwise indicated.
 - 1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7" (178 mm).
 - 2. Extend side rails 42" (1.1 m) above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.

2.11 LADDER SAFETY CAGES

- A. General: Fabricate ladder safety cages to comply with requirements of ANSI A14.3; where conflicts occur, comply with the more stringent requirements. Assemble safety cages by welding.
- B. Primary Hoops: Steel bars, 3" x ¼" (76 mm x 6.4 mm), for top, bottom, and for cages longer than 20' (6.1 m), intermediate hoops spaced not more than 20'-0" (6.1 m) o.c.
- C. Secondary Intermediate Hoops: Steel bars, 2" x ¼" (51 mm x 6.4 mm) hoops spaced not more than 4'-0" (1.2 m) o.c. between primary hoops.
- E. Vertical Bars: Steel bars, 1½" x ¼" (38.1 mm x 6.4 mm), secured to each hoop, spaced at intervals not more than 40° (0.7 rad) o.c. around the circumference of the cage, maximum spacing of approximately 9½" (241 mm) o.c.
- F. Fasten assembled safety cage to ladder rails and adjacent construction as indicated.

2.12 MISCELLANEOUS METAL ITEMS

- A. Miscellaneous Framing and Supports: Provide steel framing and supports for applications indicated, which are not parts of structural steel framework, as required to complete work.
 - 1. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 2. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Except as otherwise indicated, space anchors 24"

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(61 cm) o.c. and provide minimum anchor units in the form of steel straps 1¼" wide x ¼" x 8" long (31.8 mm x 6.4 mm x 203 mm).

- B. Miscellaneous Steel Trim: Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination for assembly and installation with other work.

2.13 METAL BAR GRATINGS

- A. General: Produce metal bar gratings of description indicated per NAAMM marking system that complies with the following:
 - 1. Metal Bar Grating Standard: "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" published in ANSI/NAAMM MBG 531.
 - 2. Heavy Duty Metal Bar Grating Standard: "Guide Specifications for Heavy Duty Metal Bar Grating" published in ANSI/NAAMM MBG 532.
- B. If gratings are located in walking surfaces, gratings shall have spaces no greater than ½" (12.7 mm) wide in one direction. If gratings have elongated openings, then they shall be placed so that the long dimension is perpendicular to the dominant direction of travel.
- C. Fabricate steel gratings to comply with requirements as indicated on the drawings.
- D. Traffic Surface for Steel and Aluminum Bar Gratings: Plain, unless otherwise indicated.
- E. Steel Finish: Shop prime paint applied in accordance with manufacturer's standard practice.
- F. Aluminum Finish: Mill (as fabricated), unless otherwise indicated.
- G. Fabricate removable grating sections with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated, or if not indicated, as recommended by manufacturer, for attachment to supports.
 - 1. Heavy Duty Grating: Provide not less than 4 anchor blocks, ¼" (6.4 mm) minimum thickness, for each section of grating composed of bearing bars over 3/16" (4.8 mm) in thickness, with each block shop-welded to 2 bearing bars.
 - 2. Non-heavy Duty Grating: Provide not less than 4 saddle clips for each grating section composed of rectangular bearing bars 3/16" (4.8 mm) or less in thickness and spaced not less than 15/16" (23.8 mm) o.c., with each clip designed and fabricated to fit over 2 bearing bars. Furnish threaded bolts with nuts and washers for each clip required, unless otherwise indicated.
- H. Attach toe plates to grating by welding, unless otherwise indicated. Toe plate height: 4" (102 mm), unless a greater height indicated.
- I. Fabricate cutouts in grating sections for penetrations indicated. Arrange layout of cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1. Edge band openings in grating that interrupt 4 or more bearing bars with bars of same size and material as bearing bars.
 - 2. Do not notch bearing bars at supports to maintain elevation.
- J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal bar gratings that may be incorporated in the work include, but are not limited to, the following:
 - 1. Alabama Metal Industries Corp
 - 2. Barnet/Bates Corp
 - 3. Big D Metals
 - 4. McNichols

2.14 STEEL PIPE GUARDRAILS AND HANDRAILS

- A. General: Fabricate pipe guardrails and handrails to comply with requirements indicated for dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacing's, and anchorage.
- B. Interconnect guardrails and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe to which end is joined, weld all around and grind smooth.
- C. Form changes in directions of railing members as follows:
 - 1. By use of welded prefabricated steel elbow fittings
 - 2. By bending, of radius indicated
 - 3. By mitering at elbow bends
- D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross- section of pipe throughout entire bend without buckling,

twisting, cracking, or otherwise deforming exposed surfaces of pipe.

- E. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- F. Close exposed ends of pipe by welding 3/16" (4.8 mm) thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4" (6.4 mm) or less.
- G. Toe Boards: Where indicated, provide toe boards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated, or if not indicated, use 4 inches high x 1/4" (102 mm x 6.4 mm) steel bar welded to each railing post.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of guardrails and handrails to other work. Furnish inserts and other anchorage devices for connecting guardrails and handrails to concrete or masonry work.
 - 1. For railing posts set in concrete, fabricate sleeves from steel pipe not less than 6" (152 mm) long and with an inside diameter not less than 1/2" (12.7 mm) greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.
 - 2. For removable railing posts, fabricate slip-fit sockets from steel pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12" of post height. Provide socket covers designed and fabricated to resist accidental dislodgement.
- I. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fills to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

2.15 STEEL FRAMED STAIRS

- A. General: Construct stairs to conform to sizes and arrangements indicated with welded connections, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
 - 1. Fabricate treads and platforms of exterior stairs to accommodate slopes to drain in finished traffic surfaces.
- B. Stair Framing: Fabricate stringers of structural steel channels, or plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers, newels, and framing members to stringers and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces.
- C. Metal Pan Risers, Sub-treads, and Sub-platforms: Shape metal pans for risers and sub-treads to conform to configuration shown. Provide thickness of structural steel sheet for metal pans as indicated.
 - 1. Form metal pans of uncoated cold-rolled steel sheet, unless otherwise indicated.
 - 2. Form metal pans of galvanized steel sheet, where indicated on the drawings.
 - 3. Attach Risers and Sub-treads to Stringers by the following methods:
 - a). Directly weld risers and sub-treads to stringers; locate welds on side of metal pans to be concealed by concrete fill.
 - b). Attach by means of brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding or bolting.
 - 4. Provide sub-platforms of configuration and construction shown, with thickness of structural steel sheet as indicated. Attach sub-platform to platform framing members with welds or as otherwise indicated. Construct sub-platforms with smooth soffits.
- D. Steel Floor Plate Treads and Platforms: Provide raised pattern steel floor plate in pattern indicated or, if not indicated, as selected from manufacturer's standard patterns.
 - 1. Form treads of 1/4" (6.4 mm) thick raised pattern steel floor plate with integral nosing and back edge stiffener. Weld steel supporting brackets to stringers and treads to brackets.
 - 2. Fabricate platforms of raised pattern steel floor plate of thickness indicated. Provide nosing matching that on treads at all landings. Secure to platform framing members with welds.
- E. Floor Grating Treads and Platforms: Provide patterns, spacing, and bar sizes indicated; fabricate to comply with NAAMM MBG 531.
 - 1. Finish being shop prime paint, unless otherwise indicated.
 - 2. Fabricate grating treads with steel plate nosing on one edge and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts or as otherwise indicated.
 - 3. Fabricate grating platforms, with nosing matching that on grating treads, at all landings. Provide toe plates at open-sided edges of grating platform. Secure grating to platform frame with welds or as otherwise

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- indicated.
- F. Stair Guardrails and Handrails: Comply with applicable requirements specified elsewhere in this section for steel pipe guardrails and handrails, and as follows:
1. Fabricate newels of steel tubing and provide newel caps of gray-iron castings, as shown.
 2. Railings may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
 3. Connect railing posts to stair framing by direct welding, unless otherwise indicated.
- 2.16 PIPE BOLLARDS
- A. Fabricate pipe bollards from 4" (102 mm) standard black steel pipe, Schedule 40, unless otherwise indicated. Cap bollards with ¼" (6.4 mm) minimum thickness steel base plate, or as otherwise indicated.
- 2.17 FINISHES
- A. General: Comply with NAAMM AMP 500 "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish metal fabrications after assembly.
- 2.18 STEEL AND IRON FINISHES
- A. General: Shop-paint uncoated surfaces of metal fabrications, except those to be embedded in concrete or masonry or to receive sprayed-on fireproofing, surfaces and edges to be welded, and galvanized surfaces, unless otherwise indicated. Comply with requirements of SSPC-PA 1 for shop painting.
- B. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process in compliance with the following requirements:
1. ASTM A123 for galvanizing both fabricated and non-fabricated iron and steel products made of uncoated rolled, pressed, and forced shapes, plates, bars, and strip 0.0299" (0.7595 mm) thick and heavier.
 2. ASTM A153 for galvanizing iron and steel hardware.
- C. Surface Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below.
1. Remove oil, grease and similar contaminants in accordance with SP-1, "Solvent Cleaning".
 2. Remove loose rust, scale, spatter, slag and other deleterious materials in accordance with SSPC.
- D. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 3.0 mils (0.076 mm). Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection.
- 2.19 ALUMINUM FINISH
- A. Mill (as fabricated) finish, unless otherwise indicated.

PART 3 – EXECUTION

- 3.1 EXAMINATION
- A. Installer shall examine the areas and conditions under which metal fabrication items are to be installed. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer and Architect.
- 3.2 PREPARATION
- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Center nosing's on tread widths with noses flush with riser faces and tread surfaces.
- C. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.
- 3.3 INSTALLATION - GENERAL
- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry

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inserts, toggle bolts, and through-bolts, lag bolts, wood screws and other connectors as required.

- B. Cutting, Fitting and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal- arch welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surfaces matches those adjacent.
- F. Grout: Follow manufacturer's recommendations for substrate preparation and application.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint or zinc chromate primer.

3.4 INSTALLATION OF METAL BAR GRATINGS

- A. General: Install gratings to comply with requirements of NAAMM grating standard that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Secure removable units to supporting members with type and size of clips and fasteners indicated, or if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Secure non-removable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.
- D. Attach toe plates to gratings by welding, at locations indicated.

3.5 INSTALLATION OF STEEL PIPE GUARDRAILS AND HANDRAILS

- A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
 - 1. Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-metallic grout, mixed and placed to comply with anchoring material manufacturer's directions.
 - 2. Anchor posts and rail ends to steel with welded connections, unless otherwise indicated.
 - 3. Anchor posts and rail ends into concrete and masonry with steel round flanges welded to post and rail ends, and anchored into wall construction with expansion shields and bolts.
 - 4. Install removable railing sections where indicated in slip-fit metal sockets cast into concrete.
 - 5. Accurately locate sockets to match post spacing.
- B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1½" (38.1 mm) clearance from inside face of handrail and finished wall surface. Locate brackets at spacing not less than 5'-0" (1.5 m) o.c., unless otherwise indicated. Secure wall brackets and wall return fittings to building construction as follows:
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 - 3. For hollow masonry anchorage, fasten brackets directly on masonry wall using toggle bolts.
 - 4. For steel framed gypsum board assemblies, fasten brackets to wood blocking using lag bolts or to metal blocking using self-tapping screws, of size and type required to support structural loads.
- C. Expansion Joints: Provide expansion joints at locations indicated, or if not indicated, at intervals not to exceed 40' (12.2 m). Provide slip joint with internal sleeve extending 2" (51 mm) beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6" (152 mm) of posts.

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3.6 INSTALLATION OF PIPE BOLLARDS

- A. General: Install bollards at locations shown on drawings. After installation, fill pipe with concrete and provide a smooth convex curve at the top of the pipe.
- B. Backfill: The backfill in the annular space around bollards not embedded in poured footings shall be by the following methods:
 - 1. Clean excess soil from hole. Do not leave loose soil at bottom of hole.
 - 2. Backfill shall be of concrete with an ultimate strength of 3,000 pounds per square inch (210.92 kgs/sq. cm) at 28 days. The hole shall not be less than 4" (101.6 mm) larger than the diagonal dimension of a round, square or rectangular bollard.

3.7 ADJUSTING AND CLEANING

- A. Touch-Up Painting of Steel Items: Immediately after erection, clean field welds, bolted connections, abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces. Apply by brush or spray to provide a minimum dry film thickness of 3.0 mils (0.076 mm).
- B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION