

**SECTION 05500
METAL FABRICATIONS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section includes the following:
1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 2. Shelf angles.
 3. Loose bearing and leveling plates.
 4. Steel weld plates and angles for casting into concrete not specified in other sections.
 5. Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles.
 6. Aluminum stairs and stair systems.
 7. No attempt is made to enumerate each item required, but to indicate parts and describe general construction and certain special items; perform work in strict conformity with the Contract Documents, approved Shop Drawings, and the Specifications; obtain field measurements of adjoining work required to locate and fit work.
- B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.
 2. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Sections include the following:
1. Division 03 Section "Cast-in-Place Concrete."
 2. Division 04 Section "Unit Masonry."
 3. Division 05 Section "Structural Steel Framing."
 4. Division 05 Section "Metal Gratings."

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

- B. Structural Performance of Stairs: Provide metal stairs and a complete stair system, capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/360 deflection ratio or ¼ inch, whichever is less.

- C. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - a. Uniform loads of 50 lbf/ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 3. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Uniform load of 25 lsf/sq. ft. applied horizontally.

- c. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."
- E. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Metal nosings and treads.
 - 3. Paint products.
 - 4. Grout.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 2. Provide templates for anchors and bolts specified for installation under other Sections.
 - 3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the registered professional engineer, in the Commonwealth of Virginia, responsible for their preparation.
 - 4. Concrete Anchor Installer Qualifications and Procedures: Submit installer qualifications. Drilled-in anchors shall be installed by an installer with a minimum of five years' experience performing similar installations. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.
- C. Samples for Verification: For each type and finish of extruded nosing and tread.

- D. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- E. Welding certificates.
- F. Qualification Data: For professional engineer, registered in the Commonwealth of Virginia.

1.04 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.6, "Structural Welding Code--Stainless Steel."

1.05 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.06 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

1.07 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Deliver all materials in good condition. Store in dry place, off ground; keep dry at all times. Handle materials to prevent damage to product or structure.
- B. Deliver all materials to the job site properly marked to identify the structure for which they are intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. W-Shapes: ASTM A 992, Grade 50.
- C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Steel Tubing: ASTM A 500, Grade B, cold-formed steel tubing.
- F. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads. Paragraph below describes typical component of metal channel framing systems such as that manufactured by Unistrut Corporation, or equal.
- G. Cast Iron: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

2.03 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B 26, Alloy 443.0-F.
- E. All Aluminum used in an exterior application shall be anodized.

2.04 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers, galvanized in accordance with ASTM A 153.
- C. High Strength Bolts: ASTM A 325, galvanized (Type 3 for corrosive locations).
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593, Type 304, Condition CW1 or CW2 for bolts and ASTM F 594 for nuts. Washers shall be ASTM A 666, Type 304.
- E. Provide a passive coating for all stainless steel fasteners and hardware.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: ASME B18.6.3.
- H. Lag Bolts: ASME B18.2.1.
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1.
- K. Lock Washers: Helical, spring type, ASME B18.21.1.
- L. Concrete Fasteners and Anchors: Fasteners and Anchors shall be of the type and size shown on the Contract Drawings, and are specified as follows:

Anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.

- 1. Anchor Bolts.
 - a. 304 Stainless Steel, unless noted otherwise on the Contract Drawings.
 - b. Size and configuration as shown on the Contract Drawings.
- 2. Mechanically Fastened Anchors.

- a. Expansion anchors shall have embedment lengths as shown in the Contract Drawings.
 - (1) 304 Stainless Steel, Condition CW1 or CW2, unless noted otherwise in the Contract Drawings.
 - (2) Acceptable manufacturers:
 - (a) "Kwik Bolt TZ" by Hilti, Inc.
 - (b) Or Equal.
 - b. Request for an alternate expansion anchor shall include the following:
 - (1) Building Code Compliance Certifications
 - (2) International Code Council Approvals
 - (3) Product Description
 - (4) Material Specifications
 - (5) Allowable Tension and Shear Static Loads
 - (6) Technical Data
 - (7) Anchor Spacing and edge Distance Reduction Factors
3. Chemically Fastened Anchors/Reinforcing Bars
- a. Sizes and embedments of chemically fastened anchors /reinforcing bars shall be as shown in the Contract Drawings.
 - b. Acceptable manufacturers:
 - (1) "HIT RE 500 Epoxy Anchoring System" as manufactured by Hilti, Inc.
 - (2) Or Equal.
 - c. Request for an alternate fastening system shall include the following:
 - (1) Building Code Compliance Certifications
 - (2) International Code Council Approvals
 - (3) Product Description
 - (4) Material Specifications
 - (5) Technical Data
 - (6) Allowable Loads
 - (7) Ultimate Strengths
 - (8) Spacing and Edge Distance Reduction Factors
 - (9) Influence of Temperature on Strength
 - (10) Resistance to Chemicals
 - (11) Installation Guidelines
4. Substitutions of the anchor types shown on the Contract Drawings shall not be permitted without approval of the Engineer

2.05 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.06 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with 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 no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts if units are installed after concrete is placed.
- C. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness, unless otherwise indicated.
 - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
 - 2. Unless otherwise indicated, provide 1/2-inch baseplates with four 5/8-inch anchor bolts and 1/4-inch top plates.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.08 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
- C. Galvanize loose steel lintels in accordance with ASTM A 123.

- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.09 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates after fabrication in accordance with ASTM A 123.
- C. Prime plates with zinc-rich primer.

2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Prime exterior and interior miscellaneous steel trim with zinc-rich primer.

2.12 LADDER SAFETY CAGES

- A. General:
 - 1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
 - 2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
 - 3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners, unless otherwise indicated.
- B. Aluminum Ladder Safety Cages:
 - 1. Primary Hoops: 1/4-by-4-inch flat bar hoops.

2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
3. Vertical Bars: 1/4-by-2-inch flat bars secured to each hoop.

2.13 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 1. ASTM A 123, for galvanizing steel and iron products.
 2. ASTM A 153, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.15 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Bright, Directional Satin Finish: No. 4.
- D. Dull Satin Finish: No. 6.

- E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.16 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. Grind weld joints smooth with adjacent finish surface.
- E. Coat aluminum in contact with dissimilar metals, masonry or lime products with one-coat of bituminous paint.

2.17 RAILING

- A. Railing

The pipe railing shall be constructed with mechanically fastened, flush-fit INTERNA-RAIL aluminum fitting system as regularly manufactured by Hollaender Manufacturing Co., or equal. The fittings shall be internally connected to the pipe by means of an internal double tang, expanded by an austenitic 302 alloy stainless steel, internal, reverse knurl, cup point, hexagon socket set screw. Pop rivets, sheet metal screws and adhesives shall not be acceptable. The fittings shall be machined of austenitic stainless steel bar stock of 302 alloy conforming to ASTM A 582, or machined castings of high tensile aluminum-magnesium alloy 535.0 manufactured in compliance with ASTM B 26, cast from high purity ingot 535.2 conforming to ASTM B 179. Flanges shall be sand cast from high-tensile aluminum-magnesium alloy 535.0 and fastened directly to the pipe by means of an external, reverse knurl, cup point, hexagon socket set screw.

Aluminum: railing shall be fabricated of standard 6061-T6 allow, Schedule 40 extruded aluminum structural pipe, in accordance with ASTM B 221; pipe shall be nominal 1-1/2", with 1.9" O.D. and 0.145" wall thickness. Pipe posts shall be 1-1/2" diameter, 80 gauge.

- B. Railing shall be a two rail system designed to meet OSHA standards. Provide additional intermediate rails where indicated on the drawings. Unless otherwise noted on the drawings, the centerline of top rail shall be 3'-6" above the walking surface and the centerline of the second rail shall be installed at mid-height. Top rail for stairs shall not be more than 34" not less than 30" above tread. Provide minimum 3" clearance on single pipe stairway handrails supported on brackets from a wall.

- C. Post spacing shall be adequate to meet loading requirements but shall not exceed 6'-0" o.c. maximum.
- D. The top surface of the top rail shall be smooth and shall not be interrupted by projecting fittings.
- E. Provide removable stainless steel chains with snap hooks were indicated.
- F. Provide expansion and contraction joints in the railing. Expansion joints must align with those in the structure to which the handrail is attached. Post spacing shall be located 1'-0" maximum to the right or left of expansion and contraction joints.
- G. Railing shall be capable of withstanding a concentrated load of at least 200 pounds applied in any direction at any point on the rail, or 50 pounds per linear foot applied in any direction at any point on the rail.
- H. Handrail post shall be base flange mounted.
- I. Removable Setting: Railing shall be set in close-fitting sleeves, bolted to sides of concrete walkways or aluminum walkway support structure.
- J. Permanent setting in concrete shall have posts set in sleeves and set in non-shrink grout.
- K. Finish: Aluminum: Clear satin anodized, 0.7 mil thickness, AS-M21C22A41. Ship the rail plastic wrapped. Remove plastic wrap after erection.
- L. Furnish 316 stainless steel safety chains across opening.
- M. A gap shall be provided at joints not to exceed 1/4". A neoprene gasket shall be provided at all gaps. Gap intervals and distance shall be as recommended by the manufacturer.

2.18 TOE BOARD

- A. Provide toe boards a minimum of 4" high at the following locations. Where stairs or stairways are exposed with open areas below. Where platforms, runways or catwalks cross over open areas or open tanks. Where indicated on the drawings.
- B. Toe boards shall be minimum 4" high extruded aluminum and attached to the posts with clamps or brackets which allow for lateral movement due to expansion and contraction between posts. Toe boards shall be set 1/4" above the walking surface. Notch toe boards as required at posts base plates.
- C. Where toe board sections terminate, splice toe board sections using a minimum 4" long bracket. The splice connection shall be a snap fit to allow expansion and contraction. Bolt, rivet, etc., type fasteners at the splice shall not be permitted. Provide a gap between the adjoining tow board sections at the splice of the dimension recommended by the manufacturer for the installation temperature.

2.19 ALUMINUM STAIRS

- A. Fit and shop assemble stair in the largest practical sections for delivery to the job site.
- B. Miter the stringers at changes in direction with joints tightly fitted and secured by continuous welds and grind with #3 NOMMA Finish. Make exposed joints butt tight. Ease exposed edges to a small uniform radius.
- C. Close and fit the ends of stringers at the floor or landing to the floor surface. On the landing and platforms where they are part of the stair framing, carry the wall stringers around and above the finished level of the platform to form a base of the height as shown.
- D. Provide standard prefabricated aluminum grating treads and aluminum nosings with extruded reinforced profile with non-slip ribs.
 - 1. Mechanically fasten grating treads with aluminum bearing angle to stringers.
 - 2. Grating bearing bars shall be spaced 1-3/16 inches on center and cross bars shall be spaced at 4 inches on center. Cross bars shall be flush at top with bearing bars.
 - 3. All grating edges shall be banded.
 - 4. Unless noted otherwise, all grating at treads and landings will not be welded to supports, provide saddle clips as required for attachment. Limit weight of each section to no more than 50 pounds.
 - 5. Provide aluminum riser plate welded to grating tread, unless indicated otherwise.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. 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 surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:

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 no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. 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.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.03 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.04 INSTALLING ALUMINUM STAIRS

- A. Install metal stair in accordance with the manufacturer's recommendations and approved shop drawings.
- B. Install components plumb and level, accurately fitted, free from distortion or defects.
- C. Securely bolt or anchor, plates, angles, hangers, and struts required for connecting stairs to structure.
- D. Provide welded field joints where specifically indicated or shop drawings. Perform field welding in accordance with the appropriate AWS Specification.
- E. Obtain written approval prior to site cutting or creating adjustments not scheduled.

3.05 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05500

**SECTION 05530
METAL GRATINGS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section includes the following:
 - 1. Extruded-aluminum bar gratings.
 - 2. Metal frames and supports for gratings.
 - 3. Prefabricated unpunched aluminum heavy duty plank gratings.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications"

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Gratings: Provide gratings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Floors: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
 - 2. Walkways and Elevated Platforms: Uniform load of 100 lbf/sq. ft.
 - 3. Limit deflection to L/360 or 1/4 inch, whichever is less.
 - 4. Unpunched aluminum heavy duty plank grating shall be designed to be removable.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Extruded-aluminum bar gratings.
 - 2. Clips and anchorage devices for gratings.
 - 3. Unpunched aluminum heavy duty plank gratings.
 - 4. The Contractor shall submit the manufacturer's catalog pages including load tables, anchor details and standard installation details.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
 - 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer, registered in the Commonwealth of Pennsylvania, responsible for their preparation.
 - 3. Drawings for the fabrication and erection of all gratings. Include plans, elevations, and details of sections and connections as required. Show type and location of all fasteners.
 - 4. Samples of gratings and anchorage systems.
- C. Mill Certificates: Signed by manufacturers certifying that products furnished comply with requirements.
- D. Welding certificates.
- E. Qualification Data: For professional engineer.

1.04 QUALITY ASSURANCE

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.6, "Structural Welding Code--Stainless Steel."
- C. Manufacturer Qualification: A company specializing in the manufacture of metal bar gratings with not less than 10 years of documented experience.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. No field trimming or fitting of grating is permitted.

1.06 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Extruded-Aluminum Bar Gratings:
 - a. McNichols Company
 - b. Alabama Metal Industries Corporation.
 - c. IKG Industries; a Harsco Company.
 - d. Ohio Gratings, Inc.
 - e. Or equal

2.02 FERROUS MATERIALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

2.03 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: ASTM B 221, alloys as follows:
 - 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
 - 2. 6061-T1, for grating crossbars.
- C. Aluminum Sheet: ASTM B 209, Alloy 6061

2.04 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts.
- D. Plain Washers: Round, ASME B18.22.1.
- E. Lock Washers: Helical, spring type, ASME B18.21.1.
- F. Anchors: Provide cast-in-place, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.05 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.06 FABRICATION

- A. Shop Assembly: Fabricate grating sections 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.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: 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.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
 - 1. Fabricate toeplates to fit grating units and weld to units in shop, unless otherwise indicated.
 - 2. Fabricate toeplates for attaching in the field.
 - 3. Toeplate Height: 4 inches, unless otherwise indicated.

2.07 METAL BAR GRATINGS

- A. Aluminum I-Bar Grating: Fabricated by swaging crossbars between bearing bars.
 - 1. Bearing Bar Spacing: 15/16 inch o.c.
 - 2. Bearing Bar Depth: 2 inch.
 - 3. Bearing Bar Flange Width: 1/4 inch.
 - 4. Crossbar Spacing: 2 inches o.c.
 - 5. Traffic Surface: Grooved.
 - 6. Aluminum Finish: Class I, clear, anodized finish.
- B. Removable Grating Sections: Fabricate 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 attaching to supports.
 - 1. Provide not less than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
 - 2. Provide not less than 4 saddle clips for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16

- inch or more o.c., with each clip designed and fabricated to fit over 2 bearing bars.
3. Provide not less than 4 weld lugs for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to 3 or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
 4. Provide not less than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
 5. Furnish threaded bolts with nuts and washers for securing grating to supports.
 6. Furnish self-drilling fasteners with washers for securing grating to supports.
 7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
 - a. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Grate-Fast" by Lindapter North America, Inc., or equal.
- C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- D. Do not notch bearing bars at supports to maintain elevation.
- E. Unpunched Aluminum Heavy Duty Plank Grating:
1. Six inch wide extruded aluminum plank with support bars spaced 1.2" on center, fabricated with banding into panels of standard width to fill areas shown on the drawings.
 - a. Plank Depth: based on loading requirements and clear span.
 - b. Top Surface: Slip Resistant.
 - c. Type: Removable.
 - d. Finish: A-41 Clear Anodized.

2.08 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1. Unless otherwise indicated, fabricate from same basic metal as gratings.
 - 2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.
- B. Galvanize steel frames and supports in the following locations:
 - 1. Exterior, unless noted otherwise.
 - 2. Interior, unless noted otherwise.

2.09 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker complying with AAMA 611.

2.10 STEEL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish gratings, frames, and supports after assembly.
- C. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with ASTM A 123.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
 - 1. 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 that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Comply with the following requirements:
 - 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.
- 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.
- H. Contractor shall take field measurements prior to preparation of final shop drawings and fabrication where required to ensure proper fitting of the work.

3.02 INSTALLING GRATINGS

- A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.
- B. Attach grating units to supporting members by bolting at every point of contact.
- C. Prior to grating installation, Contractor shall inspect supports for correct alignment and conditions for proper attachment and support of grating. Any inconsistencies between contract drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the Engineer prior to placement.
- D. Install grating in accordance with the approved shop drawings and standard installation clearances as recommended by ANSI/NAAMM MBG-531 "Metal Bar Grating Manual."

- E. Protection of Aluminum from Dissimilar Materials:
 - 1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with one coat of bituminous paint or use of other approved insulating material.
 - 2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry or mortar, exposed aluminum surfaces shall be painted with one coat of bituminous paint or use of other approved insulating material.

3.03 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05530

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