SECTION 057300 - DECORATIVE METAL RAILINGS

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

Access Manufacturer's Specpoint Product Cards:

<Double click here to view the manufacturer's product cards available at Deltek Specpoint>

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum decorative railings.
2. Stainless steel decorative railings.

B. Related Requirements:

1. Section 055213 "Pipe and Tube Railings" for nonornamental railings fabricated from pipes and tubes.
2. Section 057313 "Glazed Decorative Metal Railings."

3. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.
4. [**Section 064013 "Exterior Architectural Woodwork"**] [**Section 064023 "Interior Architectural Woodwork"**] for wood railings.

1.2 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. 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 items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at ASD offices or Microsoft Teams.

1. <**Insert participants**>.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of decorative metal railings assembled from standard components.
2. Stainless steel cable and cable fittings.
3. Perforated metal infill panels.
4. Woven-wire mesh infill panels.
5. Fasteners.
6. Post-installed anchors.
7. Handrail brackets.
8. Shop primer.
9. Intermediate coats and topcoats.
10. Bituminous paint.
11. Nonshrink, nonmetallic grout.
12. Anchoring cement.
13. Metal finishes.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include plans, elevations, sections, and attachment details.

D. Samples for Initial Selection: For products involving selection of color, texture, or design[**, including mechanical finishes**].

E. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
2. Fittings, end caps, and brackets.
3. Welded connections.
4. Cable and cable hardware and connections.
5. Assembled Sample of railing system, made from full-size components, including top rail, post, and guard infill. Sample need not be full height.

a. Show method of [**connecting**] [**and**] [**finishing**] members at intersections.

F. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [**delegated design professional engineer**] [**testing agency**].

B. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

C. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

D. Preconstruction test reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups as indicated on Drawings.
2. Build mockups for each form and finish of railing, consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: [**Owner will engage**] [**Engage**] a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made [**by Owner**] [**from the testing and inspecting allowance, as authorized by Change Orders**] [**by Contractor**]. Retesting of products that fail to meet specified requirements is to be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings in accordance with ASTM E894 and ASTM E935.
3. Notify Architect [**seven**] <**Insert number**> days in advance of the dates and times when laboratory mockups will be tested.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle decorative metal railings and accessories in accordance with manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).

b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 ALUMINUM DECORATIVE RAILINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide American Structures & Design; AS&D [**Elliptical Top (RA-TR-999)**] [**Flat Top (RA-TR-200)**] [**Round Top (RA-TR-100)**] Aluminum Railing or comparable product by one of the following:

1. C.R. Laurence Co., Inc.; CRH Americas, Inc.
2. CraneVeyor Corp.
3. Julius Blum & Co., Inc.
4. <**Insert manufacturer's name**>.

B. Source Limitations: Obtain aluminum decorative railing components from single source from single manufacturer.

C. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

D. Extruded Bars and Shapes, Including Extruded Tube: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

E. Extruded Structural Pipe and Round Tube: ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

F. Drawn Seamless Tube: ASTM B210/B210M, Alloy 6063-T832.

G. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy [**5005-H32**] [**6061-T6**].

H. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

I. Stainless Steel Infill Panels for Aluminum System:

1. Tubing: ASTM A554, Grade MT [**304**] [**316**] [**316L**].
2. Pipe: ASTM A312/A312M, Grade TP [**304**] [**316**] [**316L**].
3. Castings: ASTM A743/A743M, Grade [**CF 8 or CF 20**] [**CF 8M or CF 3M**].
4. Plate, Sheet, and Strip, Plate, and Flat Bar: ASTM A240/A240M or ASTM A666, Type [**304**] [**316**] [**316L**].
5. Flat Bar: ASTM A666, Type [**304**] [**316**] [**316L**].
6. Bars and Shapes: ASTM A276, Type [**304**] [**316**] [**316L**].

J. Stainless Steel Cable and Cable Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Structures & Design; Ultra-tec, The Cable Connection or comparable product by one of the following:

   a. C.R. Laurence Co., Inc.; CRH Americas, Inc.
   b. CraneVeyor Corp.
   c. Julius Blum & Co., Inc.
   d. <**Insert manufacturer's name**>.

2. Cable: 1-by-19 left-hand-lay wire cable made from wire complying with ASTM A492, Type 316[**, PVC jacketed**], <**Insert color**>.
3. Cable Diameter: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**3/16 inch (5 mm)**] [**1/4 inch (6.4 mm)**].
4. Cable Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of cable with which they are used.
5. Intermediate Cable Supports: Stainless steel flat bar, 1/4 by 1 inch (6.4 by 25.4 mm), predrilled.

K. Castings: ASTM B26/B26M, Alloy A356.0-T6.

L. Perforated Metal Infill Panels: Aluminum sheet, ASTM B209 (ASTM B209M), Alloy 6061-T6, [**0.063 inch (1.60 mm)**] <**Insert dimension**> thick, [**with 1/4-inch (6.4-mm) holes 3/8-inch (9.5-mm) o.c. in staggered rows**] <**Insert description**>.

1. Basis-of-Design Product: Provide product with perforations matching McNichols Co.; [**Round hole**] [**Square hole**] [**Slotted hole**] [**Hexagonal hole**] [**Decorative**] or comparable product.

M. Woven-Wire Mesh Infill Panels: Intermediate-crimp, [**square**] [**rectangle**] [**and**] [**decorative**] pattern, 2-inch (50-mm) woven-wire mesh, made from 0.162-inch (4.1-mm) nominal diameter aluminum wire complying with ASTM B211/B211M, Alloy 6061-T94.

1. Basis-of-Design Product: Provide product with crimp pattern matching <**Insert manufacturer's name; product name or designation**>.

N. Expanded Stainless Steel Sheet: ASTM F1267, Type [**I (expanded)**] [**II (expanded and flattened)**], Class 3 (corrosion-resisting steel), made from stainless steel sheet complying with ASTM A666, Type [**304**] [**316**].

1. Style Designation: [**3/4 number 13**] [**1-1/2 number 10**] <**Insert designation**>.

2.4 STAINLESS STEEL DECORATIVE RAILINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide American Structures and Design, Inc.; [**Horizontal Round Bar**] [**Horizontal Glass**] [**and**] [**Stainless Steel Cable**] Infill or comparable product by one of the following:

1. C.R. Laurence Co., Inc.; CRH Americas, Inc.
2. CraneVeyor Corp.
3. Julius Blum & Co., Inc.
4. <**Insert manufacturer's name**>.

B. Source Limitations: Obtain stainless steel decorative railing components from single source from single manufacturer.

C. Tubing: ASTM A554, [**Grade MT 304**] [**Grade MT 316**] [**Grade MT 316L**].

D. Pipe: ASTM A312/A312M, [**Grade TP 304**] [**Grade TP 316**] [**Grade TP 316L**].

E. Castings: ASTM A743/A743M, [**Grade CF 8 or CF 20**] [**Grade CF 8M or CF 3M**].

F. Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, [**Type 304**] [**Type 316**] [**Type 316L**].

G. Flat Bar: ASTM A666, [**Type 304**] [**Type 316**] [**Type 316L**].

H. Bars and Shapes: ASTM A276/A276M, [**Type 304**] [**Type 316**] [**Type 316L**].

I. Stainless Steel Cable and Cable Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Structures & Design; Ultra-tec, The Cable Connection or comparable product by one of the following:

   a. C.R. Laurence Co., Inc.; CRH Americas, Inc.
   b. CraneVeyor Corp.
   c. Julius Blum & Co., Inc.
   d. <**Insert manufacturer's name**>.

2. Cable: 1-by-19 left-hand-lay wire cable made from wire complying with ASTM A492, Type 316[**, PVC jacketed**], <**Insert color**>.
3. Cable Diameter: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**3/16 inch (5 mm)**] [**1/4 inch (6.4 mm)**].
4. Cable Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of cable with which they are used.
5. Intermediate Cable Supports: Stainless steel flat bar, 1/4-by-1-inch (6.4-by-25.4-mm), predrilled.

2.5 FASTENERS

A. Fastener Materials:

1. Aluminum Railing Components: Type [**304**] [**316**] stainless steel fasteners.
2. Stainless Steel Railing Components: Type [**304**] [**316**] stainless steel fasteners.
3. Dissimilar Metal Railing Components: Type [**304**] [**316**] stainless steel fasteners.
4. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction[**and capable of withstanding design loads**].

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless [**otherwise indicated**] [**exposed fasteners are unavoidable**] [**exposed fasteners are the standard fastening method for railings indicated**].

1. Provide [**Phillips**] [**tamper-resistant**] [**square or hex socket**] flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193[**or ICC-ES AC308**].

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [**Group 1 (A1)**] [**Group 2 (A4)**] stainless steel bolts, ASTM F593 and nuts, ASTM F594.

2.6 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast-aluminum, center of handrail [**2-1/2 inches (63.5 mm)**] [**3-1/8 inches (79.4 mm)**] <**Insert dimension**> from [**face of railing**] [**wall**].

1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.
4. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

B. Shop Primers: Provide primers that comply with [**Section 099113 "Exterior Painting."**] [**Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Intermediate Coats and Topcoats: Provide products that comply with [**Section 099113 "Exterior Painting."**] [**Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]

D. Epoxy Intermediate Coat: Compatible with primer and topcoat.

E. Polyurethane Topcoat: Compatible with undercoat.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: [**At exterior locations**] [**and**] [**where indicated on Drawings**], provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[**, but not less than that required to support structural loads**].

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water.

1. Provide weep holes where water may accumulate.
2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with mechanical connections unless otherwise indicated.

H. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.

1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

K. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

L. Stainless Steel Cable Guard Infill: Fabricate cable guard infill assemblies in the shop to field-measured dimensions with fittings machine swaged.

1. Minimize amount of turnbuckle take-up used for dimensional adjustment, so maximum amount is available for tensioning cable.
2. Tag cable assemblies and fittings to identify installation locations and orientations for coordinated installation.

M. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from [**aluminum**] [**same metal as railings in which they are installed**].

1. Orient perforated metal with pattern [**parallel to top rail**] [**perpendicular to top rail**] [**horizontal**] [**vertical**].

N. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames.

1. Fabricate wire mesh and frames from [**aluminum**] [**stainless steel**] [**steel**] [**unless otherwise indicated**].
2. Orient wire mesh with [**diamonds vertical**] [**wires perpendicular and parallel to top rail**] [**wires horizontal and vertical**].

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 ALUMINUM FINISHES

A. Powder Coat Finish: AAMA 2605 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color: [**Brown**] [**White**] [**Black**] [**Match Architect's sample**] [**As selected by Architect from full range of industry colors and color densities**].

2.10 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces.
3. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing [**to a high luster finish**] [**to a mirrorlike finish**] [**to match Architect's sample**].

D. Stainless Steel Sheet and Plate Finishes:

1. Directional Satin Finish: ASTM A480/A480M, No. 4.
2. Dull Satin Finish: ASTM A480/A480M, No. 6.
3. High-Luster Finish: ASTM A480/A480M, No. 7.
4. Mirror Finish: ASTM A480/A480M, No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 ft. (2 mm in 1 m).
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 ft. (6 mm in 3 m).

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with [**nonshrink, nonmetallic grout**] [**or**] [**anchoring cement**], mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with [**nonshrink, nonmetallic grout**] [**or**] [**anchoring cement**], mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, [**welded to post after placing anchoring material**] [**attached to post with setscrews**].

D. Leave anchorage joint exposed with [**1/8-inch (3-mm) buildup, sloped away from post**] [**anchoring material flush with adjacent surface**].

E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum railings, attach posts as indicated, using fittings designed and engineered for this purpose.
2. For stainless steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with [**sleeves concealed within**] [**flanges connected to**] [**brackets on underside of rails connected to**] railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and [**welded to railing ends**] [**or**] [**connected to railing ends, using nonwelded connections**].

C. Attach handrails to walls with wall brackets[**, except where end flanges are used**]. Provide brackets with [**1-1/2-inch (38-mm)**] <**Insert dimension**> clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with [**flange tapped for concealed anchorage to threaded hanger bolt**] [**predrilled hole for exposed bolt anchorage**].

2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets[**and railing end flanges**] to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into[**fire-retardant-treated**] wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness matching finish of railing system.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting."**] [**Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made [**by Owner**] [**from the testing and inspecting allowance, as authorized by Change Orders**].

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894 and ASTM E935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING

A. Clean [**aluminum**] [**and**] [**stainless steel**] by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.9 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300