SECTION 057300 - DECORATIVE METAL RAILINGS

GENERAL

SUMMARY

Section Includes:

- Aluminum decorative railings.
- Copper-alloy decorative railings.
- Stainless steel decorative railings.
- Steel and iron decorative railings.

Related Requirements:

- Section 055213 "Pipe and Tube Railings" for nonornamental railings fabricated from pipes and tubes.
- Section 057313 "Glazed Decorative Metal Railings."
- Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.
- [Section 064013 "Exterior Architectural Woodwork"] [Section 064023 "Interior Architectural Woodwork"] for wood railings.

COORDINATION AND SCHEDULING

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.

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.

PREINSTALLATION MEETINGS

Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

- <Insert participants>.

ACTION SUBMITTALS

Product Data:

- Manufacturer's product lines of decorative metal railings assembled from standard components.
- Illuminated rails.
- Stainless steel cable and cable fittings.
- Expanded metal infill panels.
- Perforated metal infill panels.
- Woven-wire mesh infill panels.
- Fasteners.
- Post-installed anchors.
- Handrail brackets.
- Wood rails.
- Lacquer for copper alloys.
- Shop primer.
- Intermediate coats and topcoats.
- Bituminous paint.

Nonshrink, nonmetallic grout.
Anchoring cement.
Metal finishes.

Sustainable Design Submittals:

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

For illuminated railings, include wiring diagrams and roughing-in details.

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

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

Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
Illuminated railing.
Fittings, end caps, and brackets.
Welded connections.
Brazed connections.
Cable and cable hardware and connections.
Assembled Sample of railing system, made from full-size components, including top rail, post, [**illuminated**] handrail, and guard infill. Sample need not be full height.

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

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

INFORMATIONAL SUBMITTALS

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

Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

Welding certificates.

Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

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

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

Preconstruction test reports.

QUALITY ASSURANCE

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

AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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

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

Build mockups as shown on Drawings.
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.
Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PRECONSTRUCTION TESTING

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.

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

DELIVERY, STORAGE, AND HANDLING

Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

FIELD CONDITIONS

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

PART 2 - PART 2 - PRODUCTS

PERFORMANCE REQUIREMENTS

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

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:

Handrails and Top Rails of Guards:

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

Infill of Guards:

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

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

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.

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

METALS, GENERAL

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

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

ALUMINUM DECORATIVE RAILINGS

<Double click here to find, evaluate, and insert list of manufacturers and products.>

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

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.

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

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

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

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

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

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

Illuminated [**Top**] [**Hand**] Rails: Provide internal illumination using concealed, internally wired, integrated LED [**dimmable**] lamps to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service.

LED Luminaires: Comply with [Section 265119 "LED Interior Lighting"] [Section 265619 "LED Exterior Lighting"] and as follows:

Lamp Type: [Linear] [Point] <Insert lamp description>.
Light Illumination: White, [standard] [high] output; [80 lumens/300 mm] [120 lumens/300 mm] [270 lumens/300 mm] <Insert value>.
Efficacy: Minimum [**80**] <**Insert number**> lm/W.
Color Rendering Index: Minimum [**65**] [**70**] [**80**] <**Insert number**>.
Correlated Color Temperature: [**2700 K**] [**3000 K**] [**3500 K**] <**Insert value**>.
Rated Lamp Life: [**50,000**] <**Insert number**> hours at 70 percent lamp illumination output.
Beam Distribution: [Symmetric] [Asymmetric] [10 degrees] [25 degrees] [55 degrees] [100 degrees] <Insert angle or angle range>.
LED Diffuser: UV-stabilized acrylic, [**clear**] [**translucent**], matching rail profile.
Nominal Operating Voltage: [**120 V ac**] [**277 V ac**] input; [**12 V dc**] [**24 V dc**] output.
Internal Driver: [**100**] [**120**] W.

UL Listing: [**Damp**] [**Dry**].
IP Rating: IP67.
Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Stainless Steel Cable and Cable Fittings:

<Double click here to find, evaluate, and insert list of manufacturers and products.>
Cable: [**1-by-19**] [**7-by-7**] [**7-by-19**] <**Insert configuration**> wire cable made from wire complying with ASTM A492, Type 316[**, PVC jacketed**], <**Insert color**>.
Cable Diameter: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**3/16 inch (5 mm)**] [**1/4inch (6.4 mm)**].
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.
Intermediate Cable Supports: Stainless steel flat bar, 1/4 by 1 inch (6.4 by 25.4 mm), predrilled.

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

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>.

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

Woven-Wire Mesh Infill Panels: Intermediate-crimp, [**diamond**] [**square**] 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.

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

COPPER-ALLOY DECORATIVE RAILINGS

<Double click here to find, evaluate, and insert list of manufacturers and products.>

Source Limitations: Obtain copper and copper alloy decorative metal railing components from single source from single manufacturer.

Copper and Copper Alloys, General: Provide alloys indicated and with temper to suit application and forming methods, but with strength and stiffness of not less than Temper H01 (quarter hard) for plate, sheet, strip, and bars, and of not less than Temper H55 (light drawn) for tube and pipe.

Bronze Extruded Shapes: ASTM B455, Alloy UNS C38500 (architectural bronze).

Brass Extruded Shapes: ASTM B249/B249M, Alloy UNS C36000 (free-cutting brass).

Nickel Silver Extruded Shapes: ASTM B249/B249M, Alloy UNS C79600.

Bronze Seamless Pipe: ASTM B43, Alloy UNS C23000 (red brass, 85 percent copper).

Bronze Seamless Tube: ASTM B135/B135M, Alloy UNS C23000 (red brass, 85 percent copper).

Brass Seamless Tube: ASTM B135/B135M, Alloy UNS C26000 (cartridge brass, 70 percent copper).

Copper Seamless Tube: ASTM B75/B75M, Alloy UNS C12200 (phosphorous deoxidized, high residual phosphorous copper).

Bronze Castings: [Composition bronze castings complying with ASTM B62, Alloy UNS C83600 (85-5-5-5 or No. 1 composition commercial red brass)] [or] [sand castings complying with ASTM B584, Alloy UNS C86500 (No. 1 manganese bronze)].

Brass Castings: Sand castings complying with ASTM B584, Alloy UNS C85200 (high-copper yellow brass).

Copper Castings: ASTM B824, with a minimum of 99.9 percent copper.

Nickel Silver Castings: ASTM B584, Alloy UNS C97300 (12 percent leaded nickel silver).

Bronze Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

Brass Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C26000 (cartridge brass, 70 percent copper).

Copper Plate, Sheet, Strip, and Bars: ASTM B152/B152M, Alloy UNS C11000 (electrolytic tough pitch copper) or Alloy UNS C12200 (phosphorous deoxidized, high-residual phosphorous copper).

Stainless Steel Cable and Cable Fittings:

<Double click here to find, evaluate, and insert list of manufacturers and products.>

Cable: [**1-by-19**] [**7-by-7**] [**7-by-19**] <**Insert configuration**> wire cable made from wire complying with ASTM A492, Type 316[**, PVC jacketed**], <**Insert color**>.

Cable Diameter: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**3/16 inch (5 mm)**] [**1/4 inch (6.4 mm)**].

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.

Intermediate Cable Supports: Stainless steel flat bar, 1/4-by-1-inch (6.4-by-25.4-mm), predrilled.

STAINLESS STEEL DECORATIVE RAILINGS

<Double click here to find, evaluate, and insert list of manufacturers and products.>

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

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

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

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

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

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

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

Illuminated [**Top**] [**Hand**] Rails: Provide internal illumination using concealed, internally wired, integrated LED [**dimmable**] lamps to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service.

LED Luminaires: Comply with [Section 265119 "LED Interior Lighting"] [Section 265619 "LED Exterior Lighting"] and as follows:

Lamp Type: [Linear] [Point] <Insert lamp description>.
Light Illumination: White, [standard] [high] output; [80 lumens/300 mm] [120 lumens/300 mm] [270 lumens/300 mm] <Insert value>.
Efficacy: Minimum [**80**] <**Insert number**> lm/W.
Color Rendering Index: Minimum [**65**] [**70**] [**80**] <**Insert number**>.
Correlated Color Temperature: [**2700 K**] [**3000 K**] [**3500 K**] <**Insert value**>.
Rated Lamp Life: [**50,000**] <**Insert number**> hours at 70 percent lamp illumination output.
Beam Distribution: [Symmetric] [Asymmetric] [10 degrees] [25 degrees] [55 degrees] [100 degrees] <Insert angle or angle range>.
LED Diffuser: UV-stabilized acrylic, [**clear**] [**translucent**], matching rail profile.
Nominal Operating Voltage: [**120 V ac**] [**277 V ac**] input; [**12 V dc**] [**24 V dc**] output.
Internal Driver: [**100**] [**120**] W.
UL Listing: [**Damp**] [**Dry**].
IP Rating: IP67.
Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Stainless Steel Cable and Cable Fittings:

<Double click here to find, evaluate, and insert list of manufacturers and products.>
Cable: [**1-by-19**] [**7-by-7**] [**7-by-19**] <**Insert configuration**> wire cable made from wire complying with ASTM A492, Type 316[**, PVC jacketed**], <**Insert color**>.
Cable Diameter: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**3/16 inch (5 mm)**] [**1/4 inch (6.4 mm)**].
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.
Intermediate Cable Supports: Stainless steel flat bar, 1/4-by-1-inch (6.4-by-25.4-mm), predrilled.

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

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

Perforated Metal Infill Panels: Stainless steel sheet, ASTM A240/A240M or ASTM A666, [Type 304] [Type 316L], [**0.062 inch (1.59 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>.

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

Woven-Wire Mesh Infill Panels: Intermediate-crimp, [**diamond**] [**square**] pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter stainless steel wire complying with ASTM A580/A580M, [**Type 304**] [**Type 316**].

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

STEEL AND IRON DECORATIVE RAILINGS

<Double click here to find, evaluate, and insert list of manufacturers and products.>

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

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Tubing: [ASTM A500/A500M (cold formed)] [or] [ASTM A513/A513M, Type 5].

Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

Plates, Shapes, and Bars: ASTM A36/A36M.

Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

Illuminated [**Top**] [**Hand**] Rails: Provide internal illumination using concealed, internally wired, integrated LED [**dimmable**] lamps to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service.

LED Luminaires: Comply with [Section 265119 "LED Interior Lighting"] [Section 265619 "LED Exterior Lighting"] and as follows:

Lamp Type: [Linear] [Point] <Insert lamp description>.
Light Illumination: White, [standard] [high] output; [80 lumens/300 mm] [120 lumens/300 mm] [270 lumens/300 mm] <Insert value>.
Efficacy: Minimum [**80**] <**Insert number**> lm/W.
Color Rendering Index: Minimum [**65**] [**70**] [**80**] <**Insert number**>.
Correlated Color Temperature: [**2700 K**] [**3000 K**] [**3500 K**] <**Insert value**>.
Rated Lamp Life: [**50,000**] <**Insert number**> hours at 70 percent lamp illumination output.
Beam Distribution: [Symmetric] [Asymmetric] [10 degrees] [25 degrees] [55 degrees] [100 degrees] <Insert angle or angle range>.
LED Diffuser: UV-stabilized acrylic, [**clear**] [**translucent**], matching rail profile.
Nominal Operating Voltage: [**120 V ac**] [**277 V ac**] input; [**12 V dc**] [**24 V dc**] output.
Internal Driver: [**100**] [**120**] W.
UL Listing: [**Damp**] [**Dry**].
IP Rating: IP67.
Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Stainless Steel Cable and Cable Fittings:

<Double click here to find, evaluate, and insert list of manufacturers and products.>
Cable: [**1-by-19**] [**7-by-7**] [**7-by-19**] <**Insert configuration**> wire cable made from wire complying with ASTM A492, Type 316[**, PVC jacketed**], <**Insert color**>.
Cable Diameter: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**3/16 inch (5 mm)**] [**1/4 inch (6.4 mm)**].
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.
Intermediate Cable Supports: Stainless steel flat bar, 1/4-by-1-inch (6.4-by-25.4-mm), predrilled.

Expanded Metal Infill Panels: ASTM F1267, [**Type I (expanded)**] [**Type II (expanded and flattened)**], Class 1 (uncoated).

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

Perforated Metal Infill Panels:

Cold-Rolled Steel Sheet: ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, [**0.060 inch (1.52 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**>.

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

Galvanized-Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, commercial steel Type B, [**0.064 inch (1.63 mm)**] <Insert dimension> thick, [with **1/4-inch (6.4-mm)** holes **3/8 inch (9.5 mm)** o.c. in staggered rows] [with **1/8-by-1-inch (3.2-by-25.4-mm)** round end slotted holes in staggered rows] <Insert description>.

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

Woven-Wire Mesh Infill Panels: Intermediate-crimp, [**diamond**] [**square**] pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter steel wire complying with ASTM A510/A510M.

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

FASTENERS

Fastener Materials:

Aluminum Railing Components: [**Type 304**] [**Type 316**] stainless steel fasteners.
Copper-Alloy (Bronze) Railing Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[**where concealed; muntz metal (Alloy 280) fasteners where exposed**].
Copper-Alloy (Brass) Railing Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[**where concealed; brass (Alloy 260 or Alloy 360) fasteners where exposed**].
Stainless Steel Railing Components: [**Type 304**] [**Type 316**] stainless steel fasteners.
Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
Hot-Dip Galvanized-Steel Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
Dissimilar Metal Railing Components: [**Type 304**] [**Type 316**] stainless steel fasteners.
Finish exposed fasteners to match appearance, including color and texture, of railings.

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**].

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].

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

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**].

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.

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.

MISCELLANEOUS MATERIALS

Handrail Brackets: [Cast-aluminum,] [Cast-bronze,] [Cast-brass,] [Cast-copper,] [Cast-nickel-silver,] [Cast stainless steel,] [Cast-iron] center of handrail [**2-1/2 inches (63.5 mm)**] [**3-1/8 inches (79.4 mm)**] <Insert dimension> from [face of railing] [wall].

Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.
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.

Wood Rails:

Clear, straight-grained hardwood rails secured to [**recessed**] [**exposed**] metal subrail.

Species: [Ash] [Cherry] [Red oak] [Teak] [Walnut] [White oak] <Insert species>.
Finish: [Manufacturer's standard] [Transparent polyurethane] [Penetrating oil] [Acrylic impregnated].
Staining: [None] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert description or manufacturer's name and product designation>.
Profile: [Square, **1-3/4 by 1-3/4 inches (45 by 45 mm)** with edges eased to **1/4-inch (6-mm)** radius] [Rectangular, **1-3/4 by 5 inches (45 by 127 mm)** with edges eased to **1/4-inch (6-mm)** radius] [Round, **2-inch (50-mm)** diameter] [As indicated on Drawings] <Insert description>.

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Hardwood rails complying with Section 064023 "Interior Architectural Woodwork."

Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

For [**aluminum**] [**and**] [**stainless steel**] railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

Brazing Rods: For copper-alloy railings, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.

Lacquer for Copper Alloys: Clear acrylic lacquer specially developed for coating copper-alloy products.

Etching Cleaner for Galvanized Metal: Compatible with coating system specified.

Galvanizing Repair Paint: High-zinc-dust-content paint compatible with coating system specified.

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

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

Epoxy Zinc-Rich Primer: Compatible with topcoat.

Shop Primer for Galvanized Steel: [Cementitious galvanized metal primer] [Vinyl wash primer] [Water-based galvanized metal primer].

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

Epoxy Intermediate Coat: Compatible with primer and topcoat.

Polyurethane Topcoat: Compatible with undercoat.

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

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.

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.

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.

FABRICATION

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**].

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

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

Cut, drill, and punch metals cleanly and accurately.

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

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

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

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

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

Connections: Fabricate railings with [**welded**] [**or**] [**mechanical**] connections unless otherwise indicated.

Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
Obtain fusion without undercut or overlap.
Remove flux immediately.
At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

Brazed Connections: Connect copper and copper-alloy railings by brazing. Cope components at connections to provide close fit, or use fittings designed for this purpose. Braze corners and seams continuously.

Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
Remove flux immediately.
At exposed connections, finish exposed surfaces smooth and blended, so no roughness shows after finishing and brazed surface matches contours of adjoining surfaces.

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

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

Form changes in direction as follows:

As detailed.
[By bending] [or] [by inserting prefabricated elbow fittings].
[By flush bends] [or] [by inserting prefabricated flush-elbow fittings].
[By radius bends of radius indicated] [or] [by inserting prefabricated elbow fittings of radius indicated].
By bending to smallest radius that will not result in distortion of railing member.

Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

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.

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.

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.

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

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

For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

Provide socket covers designed and fabricated to resist being dislodged.
Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

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

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

Expanded-Metal Infill Panels: Fabricate infill panels from [**aluminum**] [**stainless steel**] [**steel**] expanded-metal sheet[**unless otherwise indicated**].

Edge panels with U-shaped channels made from same metal as infill; not less than 0.043 inch (1.1 mm) thick.
Orient expanded metal with long dimension of diamonds [**parallel to top rail**] [**perpendicular to top rail**] [**horizontal**] [**vertical**].

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

Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch (1.1 mm) thick.
Orient perforated metal with pattern [parallel to top rail] [perpendicular to top rail] [horizontal] [vertical].

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.

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

Toe Boards: Where indicated on Drawings, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

GENERAL FINISH REQUIREMENTS

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

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

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.

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

ALUMINUM FINISHES

Mechanical Finish: AA-M3x; sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.

Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm] or thicker.

Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm] [AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

Color: [Champagne] [Light bronze] [Medium bronze] [Dark bronze] [Black] [Match Architect's sample] [As selected by Architect from full range of industry colors and color densities] <Insert color>.

Baked-Enamel or Powder-Coat Finish: AAMA 2603 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.

Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions[**for seacoast and severe environments**].

Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

Superior-Performing Organic Finish, Three-Coat (Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions[**for seacoast and severe environments**].

Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

Superior-Performing Organic Finish, Four-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions[**for seacoast and severe environments**].

Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

Superior-Performing Organic Finish, Single-Coat FEVE: Fluoropolymer finish complying with AAMA 2605, containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat. Prepare, pretreat, and

apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

Superior-Performing Organic Finish, Two-Coat FEVE: Fluoropolymer finish complying with AAMA 2605, containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

COPPER-ALLOY FINISHES

Finish designations for copper alloys comply with the system for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

Buffed Finish: M21 (Mechanical Finish: Buffed, smooth specular).

Hand-Rubbed Finish: M31-M34 (Mechanical Finish: Directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).

Medium-Satin Finish: M32 (Mechanical Finish: Directionally textured, medium satin).

Fine-Matte Finish: M42 (Mechanical Finish: Nondirectional finish, fine matte).

Lacquered Buffed Finish: M21-O6x (Mechanical Finish: Buffed, smooth specular; Coating: Clear organic, air dried, as specified below).

Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats in accordance with manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

Lacquered Hand-Rubbed Finish: M31-M34-O6x (Mechanical Finish: Directionally textured, fine satin; Mechanical Finish: Directionally textured, hand rubbed; Coating: Clear organic, air dried, as specified below).

Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats in accordance with manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

Lacquered Medium-Satin Finish: M32-O6x (Mechanical Finish: Directionally textured, medium satin; Coating: Clear, organic, air dried, as specified below).

Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats in accordance with manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

Lacquered Fine-Matte Finish: M42-O6x (Mechanical Finish: Nondirectional finish, fine matte; Coating: Clear, organic, air dried, as specified below).

Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats in accordance with manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: Directionally textured, fine satin; Chemical Finish: Conversion coating, sulfide)[**, with color matching Architect's sample**].

Patina Conversion Coating: M36-C12-C52 (Mechanical Finish: Directionally textured, uniform; Chemical Finish: Nonetched cleaned, degreased; Chemical Finish: Conversion coating, ammonium sulfate)[**, with color matching Architect's sample**].

STAINLESS STEEL FINISHES

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

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

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

Stainless Steel Tubing Finishes:

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

Stainless Steel Sheet and Plate Finishes:

Directional Satin Finish: ASTM A480/A480M, No. 4.
High-Luster Finish: ASTM A480/A480M, No. 7.
Mirror Finish: ASTM A480/A480M, No. 8.

STEEL AND IRON FINISHES

Galvanized Railings:

Hot-dip galvanize[**exterior**] steel and iron railings, including hardware, after fabrication.
Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
Comply with ASTM A123/A123M for hot-dip galvanized railings.
Comply with ASTM A153/A153M for hot-dip galvanized hardware.
Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner[**and as follows:**]

Comply with SSPC-SP 16.

For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with [**SSPC-SP 6/NACE No. 3.**] [**SSPC-SP 7/NACE No. 4.**] [**requirements indicated below:**]

Exterior Railings: SSPC-SP 6/NACE No. 3.
Railings Indicated To Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.

Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
Other Railings: SSPC-SP 7/NACE No. 4.

Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

Shop prime uncoated railings with [primers specified in Section 099113 "Exterior Painting"] [primers specified in Section 099123 "Interior Painting"] unless [zinc-rich primer is] [primers specified in Section 099600 "High-Performance Coatings" are] indicated.
Do not apply primer to galvanized surfaces.

Shop-Painted Finish: Comply with [Section 099113 "Exterior Painting."] [Section 099600 "High-Performance Coatings."]

Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.

Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

Powder-Coat Finish for Uncoated Ferrous Metal: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:

Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.
Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than 1.5 mils (0.04 mm).
Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

Powder-Coat Finish for Galvanized Metal: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:

Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than 1.5 mils (0.04 mm).
Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

PART 3 - PART 3 - EXECUTION

EXAMINATION

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.

INSTALLATION, GENERAL

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

Fit exposed connections together to form tight, hairline joints.
Install railings level, plumb, square, true to line; without distortion, warp, or rack.
Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
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.
Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
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 feet (6 mm in 3 m).

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

Coat concealed surfaces of [**aluminum**] [**and**] [**copper alloys**] that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

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

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

RAILING CONNECTIONS

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.

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.

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.

ANCHORING POSTS

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.

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.

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

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

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:

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

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

ATTACHING RAILINGS

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.

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**].

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.

Use type of bracket with [flange tapped for concealed anchorage to threaded hanger bolt] [predrilled hole for exposed bolt anchorage].
Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

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

For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
For hollow masonry anchorage, use toggle bolts.
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.
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.
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.
For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

REPAIR

Touchup Painting:

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.

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

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."**]

FIELD QUALITY CONTROL

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**].

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.

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.

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

CLEANING

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

Clean copper alloys in accordance with metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

Clean [**wood rails**] [**and**] [**plastic handrail caps**] by wiping with a damp cloth and then wiping dry.

Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

PROTECTION

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.

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