SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

GENERAL

SUMMARY

Section Includes:

- Glazed decorative metal railings.

Related Requirements:

- Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.

DEFINITIONS

Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor and exterior deck areas and for pedestrian guidance and support, visual separation, or wall protection.

COORDINATION AND SCHEDULING

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**>.

ACTION SUBMITTALS

Product Data:

- Metal railings assembled from standard components.
- Glass products.
- Glazing cement and accessories for structural glass railings.
- Sealant and accessories for structural glass railings.
- Fasteners.
- Wood rails.
- Lacquer for copper alloys.
- Shop primer.
- Bituminous paint.
- Nonshrink, nonmetallic grout.

Anchoring cement.

Sustainable Design Submittals:

<Double click to insert sustainable design text for certified wood.>

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

Base channel.

Each type of glass and glass edge required.

Fittings and brackets.

Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, [**structural glass balusters,**] [**and**] [**glass-infill panels**]. Show method of finishing members at intersections. Samples need not be full height.

Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

INFORMATIONAL SUBMITTALS

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

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

Product Test Reports: For tests performed by a qualified testing agency, in accordance with ASTM E894, ASTM E935, ASTM E2353, and ASTM E2358.

Evaluation Reports: From ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

For glazed decorative metal railings.

For post-installed anchors.

Preconstruction test reports.

QUALITY ASSURANCE

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 indicated on Drawings.

Build mockups for each form and finish of glass-infill panel railing consisting of two posts, top rail, handrail, glass-infill panel, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.

Build mockups for each form and finish of structural glass railing consisting of top rail, structural glass, base channel, 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, ASTM E935, ASTM E2353, and ASTM E2358.

Notify Architect [**seven**] <**Insert number**> days in advance of the dates and times when laboratory mockups will be tested.

FIELD CONDITIONS

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

WARRANTY

Manufacturer's Special Warranty for Laminated Glass: Glazed decorative metal railing manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

Warranty Period: [**Five**] [**10**] <**Insert number**> years from date of Substantial Completion.

PART 2 - PRODUCTS

PERFORMANCE REQUIREMENTS

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

General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

Aluminum: The lesser of minimum yield strength divided by 1.65, or minimum ultimate tensile strength divided by 1.95.

Copper Alloys: 60 percent of minimum yield strength.

Stainless Steel: 60 percent of minimum yield strength.

Steel: 72 percent of minimum yield strength.

Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA CW-12, "Structural Properties of Glass."

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.

Structural Glass Railings and Glass-Infill Panels:

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.

For structural glass railings, support each section of top rail [**and handrail**]by a minimum of three glass panels or by other means so railings will remain in place if any one glass panel fails.

Support top rail [**and handrail**]ends such that railings remains in place if end glass panel fails.

Wind Loads: For exterior glazed decorative metal railings, capable of withstanding the following wind loads in accordance with the IBC and ASTM E1300:

Wind Load: [As indicated on Drawings] <Insert wind load>.

Windborne-Debris-Impact Resistance: Exterior glazed decorative metal railings passing ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone [**1**] [**2**] [**3**] [**4**] for [**basic**] [**enhanced**] protection.

Large-Missile Test: For exterior glazing located within [**30 feet (9.1 m)**] <**Insert dimension**> of grade.

Small-Missile Test: For exterior glazing located between 30 feet (9.1 m) and [**60 feet (18.3 m)**] <**Insert dimension**> above grade.

Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

Temperature Change: [**120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces] <Insert temperature change>.

GLAZED DECORATIVE METAL RAILINGS

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

Source Limitations for Laminated Glass: Obtain from single source from single manufacturer.

Source Limitations for Decorative Metal Railing Components: Obtain from single source from single manufacturer for each component and installation method.

Product Options: Information on Drawings and in the Specifications establishes requirements for railing system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

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

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 Tubing: ASTM B210 (ASTM 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.

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

STAINLESS STEEL

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

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

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

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

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

STEEL AND IRON

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

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

COPPER ALLOYS

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

GLASS AND GLAZING PRODUCTS, GENERAL

Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

NGA/GANA Publications: [**"GANA Laminated Glazing Reference Manual" and**]"GANA Glazing Manual."

Safety Glazing: Glazing is to comply with 16 CFR 1201, Category II.

Safety Glazing Labeling: Permanently mark glass with certification label of [**the SGCC**] [**the SGCC or another certification agency acceptable to authorities having jurisdiction**] [**or**] [**manufacturer**]. Label is to indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

Low-Iron Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.

Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Class 1 and low-iron clear, or Class 2 (tinted) as indicated, Quality-Q3.

Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

Ceramic-Coated Glass: Heat-strengthened float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual" and with other requirements specified.

Bent Glass: ASTM C1464, [Kind BFT (bent, tempered)] [Kind BHS, (bent, heat strengthened)] [Kind BL, (bent, laminated)].

Glazing Cement and Accessories for Structural Glass Railings: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.

Sealant and Accessories for Structural Glass Railings: Sealant, gaskets, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.

Glazing Gaskets for Glass-Infill Panels: Glazing gaskets and related accessories as recommended or supplied by railing manufacturer for installing glass-infill panels in post-supported railings.

GLASS HANDRAILS AND GUARDS

Tempered Glass Handrails and Guards: Provide products that have been tested for surface and edge compression in accordance with ASTM C1048 and for impact strength in accordance with 16 CFR 1201 for Category II materials.

Glass Color: [Clear] [Blue] [Blue-green] [Bronze] [Green] [Gray] <Insert color>.

Thickness for Structural Glass Balusters: As required by structural loads, but not less than [**12.0**] [**19.0**] mm.

Thickness for Glass-Infill Panels: As required by structural loads, but not less than [**6.0**] [**10.0**] mm.

Glass Thickness: As indicated on Drawings.

Laminated Glass Handrails and Guards: ASTM C1172, Type II with two plies of glass bonded together by an interlayer.

Construction: Laminate glass with [**polyvinyl butyral interlayer**] [**or**] [**ionoplast polymer interlayer**] to comply with interlayer manufacturer's written instructions.

Interlayer Thickness: [**0.030 inch (0.76 mm)**] [**0.060 inch (1.52 mm)**] [**0.090 inch (2.29 mm)**].

Kind: [LHS (laminated heat strengthened)] [LT (laminated tempered)] [As indicated].

Glass Color: Inner-ply [clear] [low-iron clear] [blue] [blue-green] [bronze] [green] [gray] <Insert color>; outer-ply [clear] [low-iron clear] [blue] [blue-green] [bronze] [green] [gray] <Insert color>.

Ceramic Coating Color and Pattern: [As selected by Architect from manufacturer's full range] <Insert manufacturer's color and pattern designation>, applied to [inner] [outer] glass ply.

Interlayer Color: [Clear] [Blue-green] [Bronze light] [Gray] <Insert color>.

Interlayer Color and Pattern: [As selected by Architect from manufacturer's full range] [Match] [Provide] <Insert manufacturer's color and pattern designation>.

Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than [**6.0**] [**8.0**] mm thick each.

Glass Plies for Glass-Infill Panels: Thickness required by structural loads, but not less than [**3.0**] [**4.0**] [**5.0**] mm each.

Windborne-Debris-Impact-Resistant Laminated Glass Guards: ASTM C1172, Type II with two plies of glass bonded together with an interlayer.

Construction: Laminate glass with [**polyvinyl butyral interlayer**] [**or**] [**ionoplast polymer interlayer**] to comply with interlayer manufacturer's written instructions.

Interlayer Thickness: [**0.060 inch (1.52 mm)**] [**0.090 inch (2.29 mm)**].

Kind: [LHS (laminated heat strengthened)] [LT (laminated tempered)] [As indicated].

Glass Color: Inner-ply [clear] [low-iron clear] [blue] [blue-green] [bronze] [green] [gray] <Insert color>; outer-ply [clear] [low-iron clear] [blue] [blue-green] [bronze] [green] [gray] <Insert color>.

Ceramic Coating Color and Pattern: [As selected by Architect from manufacturer's full range] <Insert manufacturer's color and pattern designation>, applied to [inner] [outer] glass ply.

Interlayer Color: [Clear] [Blue-green] [Bronze light] [Gray] <Insert color>.

Interlayer Color and Pattern: [As selected by Architect from manufacturer's full range] [Match] [Provide] <Insert manufacturer's color and pattern designation>.

Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than [**6.0**] [**8.0**] [**10**] mm thick each.

Glass Plies for Glass-Infill Panels: Thickness required by structural loads, but not less than [**4.0**] [**5.0**] mm each.

FASTENERS

Fastener Materials: Unless otherwise indicated, provide the following:

Aluminum Components: [**Type 304**] [**Type 316**] stainless steel fasteners.

Stainless Steel Components: [**Type 304**] [**Type 316**] stainless steel fasteners.

Copper-Alloy (Bronze) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[**where concealed; muntz metal (Alloy 280) fasteners where exposed**].

Copper-Alloy (Brass) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners[**where concealed; brass (Alloy 260 or Alloy 360) fasteners where exposed**].

Dissimilar Metals: [**Type 304**] [**Type 316**] stainless steel fasteners.

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 indicated[**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 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/ASTM 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 (ASTM F836M).

MISCELLANEOUS MATERIALS

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

Wood Rails:

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

Species: [Ash] [Cherry] [Red oak] [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] <Insert description>.

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

<Double click to insert sustainable design text for certified wood.>

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

Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

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 Anchoring Cement: [**At exterior locations**] [**and**] [**where indicated**] 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 OF METAL RAILINGS

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**].

Assemble railings in the shop 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.

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 end fittings.

Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other work where 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 [**steel**] [**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.

FABRICATION OF GLASS PANELS AND BALUSTERS

Fabricate glass to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

Glass-Infill Panels: Provide [tempered] [laminated, heat-strengthened] [laminated, tempered] glass-infill panels[for both straight and curved sections].

Edge Finish: [Clean-cut or flat-grind edges to produce smooth, square edges with slight chamfers at junctions of edges and faces] <Insert edge finishes>.

Structural Glass Balusters: Provide [tempered] [laminated, heat-strengthened] [laminated, tempered] structural glass balusters[for both straight and curved sections].

Edge Finish: [Grind smooth and flat polish exposed edges of glass, including those at open joints, to produce smooth, square edges with glass edge finishes].

Factory-bond structural glass balusters to aluminum base and top-rail channels in railing manufacturer's plant using [**glazing cement**] [**sealant**] to comply with manufacturer's written instructions[**, unless field glazing is standard with manufacturer**].

Fabricate structural glass balusters to maintain equal length glass widths and uniform spacing of [**1/2 inch (13 mm)**] <**Insert spacing**> between glass balusters.

METAL FINISH REQUIREMENTS, GENERAL

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 not acceptable. 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 PVDF: Fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent 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 PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent 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 PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent 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. 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. 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>.

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, Strip, Plate, and Bar Finishes:

Directional Satin Finish: ASTM A480/A480M, No. 4.

High Luster Finish: ASTM A480/A480M, No. 7.

Mirror Finish: ASTM A480/A480M, No. 8.

COPPER-ALLOY FINISHES

Finish designations for copper alloys comply with the system for designating copper-alloy finish systems defined in NAAMM/NOMMA 500, "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 per 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 per 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 per 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 per 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.

Color: Match 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**].

PART 3 - EXECUTION

INSTALLATION, GENERAL

Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.

Windborne-Debris Resistance: Anchor glazed decorative metal railings to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne-debris-resistance testing.

Perform cutting, drilling, and fitting required for installing metal 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 metal 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 (5 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 [**shop primer**] [**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.

METAL 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.

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.

METAL ANCHORING POSTS

Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted in 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.

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

INSTALLATION OF GLASS BALUSTERS

Structural Glass Railings:

Install assembly to comply with railing manufacturer's written instructions.

Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass balusters[**if glass was bonded to base and top-rail channels in factory**].

For field-assembled balusters, attach base channel to building structure, insert glass in base channel, and bond with [**glazing cement**] [**sealant**].

Support glass balusters in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement.
Fill remaining space in base channel with [**glazing cement**] [**sealant**] for uniform support of glass.

Adjust spacing of glass balusters so gaps between balusters are equal before securing in position.

Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

Post-Supported Railings with Glass-Infill Panels:

Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles.

Erect posts and other metal railing components, and set factory-cut glass-infill panels.

Do not cut, drill, or alter glass-infill panels in field. Protect edges from damage.

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, ASTM E935, ASTM E2353, and ASTM E2358 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 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 and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

Clean wood rails by wiping with a damp cloth and then wiping dry.

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 057313