



## SECTION 05 73 13

### GLASS BALUSTRADE RAILING SYSTEMS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, Division 01 - General Requirements, and other applicable specification sections in the Project Manual apply to the work specified in this Section.

##### 1.2 SUMMARY

- A. Scope: Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for glass balustrade railing systems as required for the complete performance of the work, and as shown on the Drawings and as herein specified.
- B. Section Includes: The work specified in this Section includes, but shall not be limited to, glass-supported metal railings.
- C. Related Sections:
  - 1. Section 05 70 00 - Decorative Metal: Adjacent or adjoining handrails and railings fabricated from steel pipe and tube components.

##### 1.3 REFERENCES

- A. General: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
- B. Aluminum Association, Inc. (AA):
  - 1. AA SAS-30, "Specifications for Aluminum Structures."
- C. American Architectural Manufacturers Association (AAMA):
  - 1. AAMA 2604, "Voluntary Specification, Performance Requirements, and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels."
  - 2. AAMA Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- D. American Iron and Steel Institute (AISI):
  - 1. AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."
- E. American Welding Society (AWS):
  - 1. AWS D1.2, "Structural Welding Code – Aluminum."

- F. ASTM International (ASTM):
  1. ASTM B26/B26M, "Standard Specification for Aluminum-Alloy Sand Castings."
  2. ASTM B209/B209M, "Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate."
  3. ASTM B210/B210M, "Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes."
  4. ASTM B221/B221M, "Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes."
  5. ASTM B247/B247M, "Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings."
  6. ASTM B429/B429M, "Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube."
  7. ASTM C1048, "Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass."
  8. ASTM E488, "Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements."
  9. ASTM E985, "Standard Specification for Permanent Metal Railing Systems and Rails for Buildings."
- G. Code of Federal Regulation (CFR):
  1. 16 CFR Part 1201, "Safety Standard for Architectural Glazing Material" (Consumer Products Safety Commission).
- H. National Association of Architectural Metal Manufacturers (NAAMM):
  1. NAAMM MFM, "Metal Finishes Manual."

#### 1.4 DEFINITIONS

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Below defines terms that can be useful in identifying railings relative to structural performance.

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- A. See definitions in ASTM E985 for railing-related terms that apply to this Section.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General: Glass balustrade railing systems shall withstand structural loading as determined by allowable design working stresses of materials based on the following standards.
  1. Aluminum: AA SAS-30.
  2. Cold-Formed Structural Steel: AISI SG-673, Part I.
  3. Glass: Fully tempered glass in glass balustrade railing systems require a design with a safety factor of three applied to the applicable modulus of rupture listed in "Mechanical Properties" in AAMA Aluminum Curtain Wall Series No. 12.
- B. Structural Performance: Provide glass balustrade railing systems capable of withstanding the following structural loads without exceeding allowable design working stress of materials for railings, anchors, and connections:
  1. Top Rail: Shall withstand the following loads:
    - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
    - b. Uniform load of 50 lbf per foot (730 N/m) applied horizontally or vertically downward.
    - c. Concentrated and uniform loads above need not be assumed to act concurrently.
  2. Handrails not Serving as Top Rails: Shall withstanding the following loads:
    - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
    - b. Uniform load of 50 lbf per foot (730 N/m) applied in any direction.
    - c. Concentrated and uniform loads above need not be assumed to act concurrently.
  3. Infill Area: Shall withstand the following loads:

- a. Concentrated horizontal load of 50 lbf (222 N) applied to 1 square foot (0.09 m<sup>2</sup>) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Loads need not be assumed to act concurrently with loads on top rails in determining stress on guard.
  - 4. Glass Balustrade Railing Systems: Capable of withstanding loads indicated for top rail and infill areas of guardrail systems, with each section of top rails supported by a minimum of three glass panels or by another means so that it remains in place should any one panel fail.
- C. Thermal Movements: Glass balustrade railing systems shall allow for movements resulting from 120 degree F (49 degree C) changes in ambient and 180 degree F (82 degree C) surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- D. Corrosion Resistance: Separate incompatible materials to prevent galvanic corrosion.

## 1.6 SUBMITTALS

- A. General: Submit under provisions of Section 01 33 00 - Submittal Procedures.
- B. Product Data:
  - 1. Submit manufacturer's data sheets on each product to be used, including, but not limited to, the following:
    - a. Preparation instructions and recommendations.
    - b. Storage and handling requirements and recommendations.
    - c. Installation methods.
  - 2. Submit product data for manufacturers product lines of glass balustrade railing systems assembled from standard components.
- C. Shop Drawings: Submit shop drawings showing fabrication and installation of glass balustrade railing systems. Include plans, elevations, sections, details, and attachments to other work.
- D. Samples:
  - 1. Color Selection: Submit manufacturer's color charts showing the full range of colors available for products with factory-applied color finishes.
  - 2. Finish Selection: Provide sections of railing or flat sheet metal which depict available mechanical surface finishes.
  - 3. Verification Samples: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
    - a. 6 inch (152 mm) long sections of each different linear railing member, including handrails and top rails.
- E. Quality Control Submittals:
  - 1. Design Data: For installed glass balustrade railing systems indicated to comply with certain design loadings, include structural analysis data signed and sealed by the professional engineer who was responsible for their preparation.
  - 2. Qualification Data: Submit documentation demonstrating capability and experience in performing installations of the same type and scope as specified by this Section. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

## 1.7 QUALITY ASSURANCE

- A. Qualifications:

1. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of glass balustrade railing systems of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 15 years.
  2. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing glass balustrade railing systems similar in type and scope to that required for this Project.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

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Retain below if required for the Project.

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- C. Mock-Ups: Prior to installation of the work, fabricate and erect mock-ups for each type of finish and application required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for final unit of work. Locate mock-ups on site in location and of size indicated or, if not indicated, as directed by the Architect. Demonstrate the proposed range of aesthetic effects and workmanship to be expected in the completed work. Obtain the Architect's acceptance of mock-ups before start of final unit of work. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of work.
1. When directed, demolish and remove mock-ups from the Project site.

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Select above or below.

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2. Accepted mock-ups in undisturbed condition at time of Substantial Completion may become part of completed unit of work.
- D. Single Source Responsibility: Obtain glass balustrade railing systems from a single source with resources to produce products of consistent quality in appearance and physical properties without delaying the work.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Store products in manufacturer's unopened packaging until ready for installation.
  - B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- 1.9 PROJECT CONDITIONS
- A. Field Measurements: Take field measurements prior to fabrication of the work and preparation of shop drawings, to ensure proper fitting of the work.
  - B. Environmental Requirements: Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- 1.10 WARRANTY
- A. General: See Section 01 77 00 - Closeout Procedures.
  - B. Warranty: Provide manufacturer's standard form outlining the terms and conditions of their Standard Limited Warranty:

1. Surface Finish Warranty: One-year limited warranty.
  2. Material Integrity Warranty: One-year limited warranty.
- C. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- 1.11 EXTRA MATERIALS
- A. All supplemental materials not expressly specified in this section shall be approved by the Architect prior to installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design: Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect will be the sole judge of the basis of what is equivalent.

### 2.2 MATERIALS

- A. Application/Scope of Work: Glass-supported metal railings.
- B. Basis of Design: Hansen Architectural Systems, Inc.; 5500 SE Alexander Street, Hillsboro, OR 97123; Toll Free Tel: 800-599-2965, Fax: 503-356-8478; Email: info@aluminumrailing.com; Web: www.aluminumrailing.com.
- C. Metals: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.
1. Aluminum: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy and temper designated below for each aluminum form required.
    - a. Extruded Bar and Tube: ASTM B221/B221M, Alloy 6063-T5/T52.
    - b. Extruded Structural Pipe and Tube: ASTM B429/B429M, Alloy 6063-T832.
    - c. Drawn Seamless Tube: ASTM B210/B210M, Alloy 6063-T832.
    - d. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
    - e. Die and Hand Forgings: ASTM B247/B247M, Alloy 6061-T6.
    - f. Castings: ASTM B26/B26M, Alloy A356-T6.
  2. Brackets, Flanges, and Anchors: Provide cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.
    - a. Provide cast brackets with flange tapped for concealed anchorage to threaded hanger bolt.
    - b. Provide formed or cast brackets with predrilled hole for exposed bolt anchorage.
    - c. 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.
    - d. Provide brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.
- D. Railing Components:
1. Extruded Aluminum Components: Provide manufacturer's standard extruded aluminum components as follows:
    - a. Aluminum Base Shoe: 2 inches (51 mm) by 4 inches (102 mm), Alloy 6063-T6.

- b. Top Rail: Circular cross section, radius as indicated on the Drawings or, if not indicated, as selected by the Architect from the manufacturer's standards with an open bottom, 0.0866 inch (2.20 mm) wall thickness.

E. Glass Products and Glazing Materials:

1. Glass: Provide fully tempered, uncoated, transparent flat glass meeting the requirements of ASTM C1048, Type FT, Condition A, Type 1, Quality q3. Products shall comply with properties indicated for class, thickness, and manufacturing process that have been tested for surface and edge compression according to ASTM C1048 and for impact strength according to 16 CFR Part 1201 for Category II materials.
  - a. Clear Glass: Class 1 (clear).
  - b. Thickness: 1/2 inch (13 mm) except where noted, and as required to support structural loads.
  - c. Manufacturing Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option. Horizontal process shall be performed tongless. Glass shall be free of tong marks and other visual distortions.
  - d. Marking: Subject to compliance with requirements, provide glass permanently marked with certification label of Safety Glazing Certification Council or other agency acceptable to authorities having jurisdiction.
2. Glazing Cement and Accessories: Provide glazing cement and related accessories recommended or supplied by railing manufacturer for bonding glass to metal subrails.

F. Fasteners:

1. Railing Anchors: Select fasteners of type, grade and class required to produce connections suitable for anchoring glass balustrade railing systems to other types of construction indicated and capable of withstanding design loads.
2. Railing Component Anchors: Use fasteners fabricated from same basic metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
  - a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are standard fastening method for handrail and railing indicated.
  - b. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
3. Cast-in-Place and Post Installed Anchors: Provide anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four items the load imposed when installed in concrete, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

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Select anchor types required. Delete others not required for this Project.

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- a. Cast-in-place anchors.
- b. Chemical anchors.
- c. Expansion anchors.

## 2.3 FABRICATION

- A. Assemble glass balustrade railing systems in 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.
- B. Form changes in direction of railing members as shown on the Drawings.

- C. Fabricate glass balustrade railing systems by connecting members with railing manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- D. Tempered glass shall be cut to final size and shape before heat treatment; provide for proper edge clearance and bite on glass. Provide thickness indicated on the Drawings, not less than required to support structural loads.
- E. Provide inserts and other anchorage devices to connect glass balustrade railing systems to concrete or masonry. Fabricate anchorage devices capable of withstanding loads imposed by glass balustrade railing systems. Coordinate anchorage devices with supporting structure.
- F. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- G. Cut, reinforce, drill, and tap components as indicated on the Drawings to receive finish hardware, screws, and similar items.
- H. Close exposed ends of railing members with prefabricated end fittings.

2.4 FINISHES

- A. General: Comply with NAAMM MFM for recommendations for applying and designating finishes.
  - 1. Appearance of Finished Work:
    - a. Variations in appearance of abutting or adjacent units are acceptable if they are within one-half of the range of final samples. Noticeable variations in the same unit are not acceptable.
    - b. Variations in appearance of other components are acceptable if they are within the range of final samples and are assembled or installed to minimize contrast.
- B. Aluminum Finish: Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

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Retain finishes below which are applicable to the Project.

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- 1. Powder Coat Finish: AA-C12-C42-R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply manufacturer's standard baked powder coat finish. Comply with coating manufacturer's written instructions for cleaning, surface preparation, pretreatment, and application.
  - a. Material: Polyester powder coating, 3.0 mil (0.076 mm). Comply with AAMA 2604, including, but not limited to, average film thickness. Subject to compliance with requirements, provide one of the following products:
    - 1) "1PC-406 Series," Forrest Paint Co.
    - 2) "Series 38," TIGER Drylac U.S.A., Inc.

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Insert color and gloss below.

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- b. Color: [\_\_\_\_\_].
- c. Gloss: [\_\_\_\_\_].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
  - 1. Examine substrates to receive anchors verifying that locations of concealed reinforcements have been clearly marked for the Installer. Locate reinforcements and mark locations if not already done.
  - 2. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

### 3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchors, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the Project site.

### 3.3 INSTALLATION

- A. General:
  - 1. Fitting: Fit exposed connections together to form tight, hairline joints.
  - 2. Cutting and Placement: Set glass balustrade railing systems accurately in location, alignment, and elevation measured from established lines and levels and free from rack.
    - a. Do not weld, cut, or abrade coated or finished surfaces of railing components that are intended for field connection by mechanical or other means without further cutting or fitting.
    - b. Align rails so variations from level or parallel alignment do not exceed 1/4 inch in 12 feet (1.6 mm per m).
    - c. Provide manufacturer's proprietary system to evacuate entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources, in order to prevent water from entering the concrete slab. In lieu of the manufacturer's proprietary system, if acceptable to the Architect, provide another means to evacuate the entrapped water, i.e., a weep hole and epoxy fill system ("drill-and-fill").
  - 3. Corrosion Protection: Provide separation as recommended by manufacturer on concealed surfaces of aluminum that will be in contact with concrete, masonry, wood, or dissimilar metals.
  - 4. Adjusting: Adjust glass balustrade railing systems before anchoring to ensure alignment at abutting joint's space at interval indicated, but not less than required to achieve structural loads.
  - 5. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing glass balustrade railing systems and for properly transferring loads to in-place construction.
- B. Non-Welded Railings Connections: Use mechanical joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.
- C. Glass-Supported Metal Railing Installation: Install assembly to comply with railing manufacturer's instructions, to listed tolerances, beginning with attachment of base channel to building structure, followed by insertion and connection of factory-fabricated and assembled glass panels.

### 3.4 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and appoint exposed areas with same material.
- B. Cleaning: Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.



### 3.5 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the glass balustrade railing systems shall be without damage at time of Substantial Completion.
- B. Protect finishes of glass balustrade railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

END OF SECTION