

SECTION 05 52 16 ALUMINUM RAILINGS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
 2. American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete.
 3. American Iron and Steel Institute (AISI).
 4. ASTM International (ASTM):
 - a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - b. A194/A194M, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 - d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 - e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
 5. International Code Council (ICC): International Building Code (IBC).
 6. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

- A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.
- B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.
- C. Special Inspection: As defined by the ICC IBC.
- D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 DESIGN REQUIREMENTS

- A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.
1. Top Rail:
 - a. Capable of withstanding the following load cases applied:
 - 1) Concentrated load of 200 pounds applied at any point and in any direction in accordance with ICC IBC and OSHA.
 - 2) Uniform load of 50 pounds per linear foot applied in any direction in accordance with ICC IBC.
 - 3) Concentrated load need not be assumed to act concurrently with uniform loads in accordance with ICC IBC.
 2. Toeboard: Capable of withstanding, without failure, force of at least 50 pounds applied in downward or outward direction at any point along toeboard.
 3. Calculated lateral deflection at top of posts shall not exceed 1 inch.

1.04 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
 - b. Manufacturer's literature and catalog data of railing and components.
 - c. Design Data:
 - 1) Calculations or test data using specified design performance loads and including the following:
 - a) Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.
 - b) Design of post base connection.
 - c) Documentation that concrete anchors have been designed in accordance with one of the following:
 - (1) ACI 318, Chapter 17.
 - (2) ICC Evaluation Services Report for selected anchor.
- B. Informational Submittals:
1. Manufacturer's assembly and installation instructions.
 2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed anchors.

3. Test Reports:
 - a. Test data may supplement load calculations providing data covers complete railing system, including anchorage:
 - 1) Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 1910, using design loads specified. Include test data for the following:
 - a) Railing and post connections.
 - b) Railing wall connections.
 - c) Railing expansion joint connections.
 - d) Railing system gate assembly, including latch, gate stop, and hinges. Both gate latch and stop to support required loads applied independent of each other.
 - 2) Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with ICC IBC.
 - 3) Deflection Criteria: In accordance with ASTM E985 and design loads specified, except as follows:
 - a) Maximum calculated lateral deflection at top of posts shall not exceed 1 inch.
 - 4) Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.
 4. Manufacturer's written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.05 QUALITY ASSURANCE

- A. Qualifications: Calculations required for design data shall be stamped by a registered civil or structural engineer licensed in state where Project will be constructed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to extent possible until railing is completely installed.
- B. Delivery:
 1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.
 2. Deliver toeboards loose for field assembly.

3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.

1. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 2 PRODUCTS

2.01 ALUMINUM RAILINGS

A. General:

1. Furnish pre-engineered and prefabricated railing systems as shown on the Drawings.
2. Railing systems using pop rivets or glued railing construction are not permitted.
3. Sand cast accessories and components are not permitted.
4. Fasteners shall be AISI Type 304 or Type 316 stainless steel, unless otherwise noted.

B. Rails, Posts, and Formed Elbows:

1. Physical Characteristics:

a. Rails, Posts, and Formed Elbows:

- 1) Extruded Alloy 6105-T5, 6061-T6, or equivalent.
- 2) Tensile Strength: 38,000 psi, minimum.
- 3) Yield Strength: 35,000 psi, minimum.
- 4) Nominal Wall Thickness: 0.145 inch, minimum.

b. Posts and railings shall be nominal 1-1/2-inch diameter (1.90-inch outside diameter). Fittings and Accessories:

- 1) Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.
- 2) Gauge metal components are not acceptable for load-resisting components.
- 3) Fittings shall match color of pipe in railings.

- c. Miscellaneous Extruded Aluminum Parts: Alloy 6063-T6, Alloy 6061-T6, or Alloy 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.
- d. Castings for Railings:
 - 1) Cast Al-mag with sufficient strength to meet load and test requirements.
 - 2) Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.
- e. Post Anchorages:
 - 1) Refer to standard details for types of post anchorages and minimum requirements.
 - 2) Bolts at anchorages shall be minimum 1/2-inch diameter.
- f. Wall Brackets: Adjustable wall fitting, with provision for minimum three 3/8-inch diameter AISI Type 304 or Type 316 stainless steel bolts or concrete anchors.
- g. Rail Terminals (including Wall Returns): Aluminum wall fitting with provision for three 3/8-inch Type 304 fasteners.
 - 1) Railing System Gate: Extruded aluminum rail components.
- h. Toeboards:
 - 1) Molded or extruded Alloy 6063-T6 or Alloy 6061-T6 aluminum.
 - 2) Provide slotted holes for expansion and contraction where required.
- i. Fasteners: AISI Type 316 stainless steel.
- j. Finishes:
 - 1) Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
 - 2) Cast Fittings and Toeboards: In accordance with AA DAF45, designation AA-M10-C22-A41.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Physical Characteristics:

- 1. Locknuts, Washers, and Screws:
 - a. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI Type 304 or Type 316 stainless steel.
 - b. Flat Washers: Molded nylon.
- 2. Bolts and Nuts for Bolting Railing to Metal Beams:

ASTM A193/A193M and ASTM A194/A194M, Type 304 or Type 316 stainless steel.

3. Concrete Anchors:
 - a. Stainless steel, AISI Type 304 or Type 316.
 - b. Post-installed anchors in accordance with Section 05 05 19, Post-Installed Anchors, unless otherwise specified herein.
 - c. Bolt Diameter: 1/2-inch, minimum.

B. Functional Characteristics: None.

C. Performance Characteristics: None.

2.03 FABRICATION

A. Shop Assembly:

1. Post Spacing: Maximum 6-foot horizontal spacing.
2. Railing Posts Bolted to Metal or Concrete:
 - a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
 - b. Field fit-up is required.
3. Free of burrs, nicks, and sharp edges when fabrication is complete.
4. Welding is not permitted.

B. Shop/Factory Finishing:

1. Use same alloy for uniform appearance throughout fabrication for railings.
2. Railing and Post Fittings: Match fittings with color of pipe in railing.

C. Shop Assembly:

1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
2. Fit dowels tightly inside posts.

D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.01 GENERAL

- A. Field fabrication of aluminum railing systems is not permitted.
- B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.
- C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds

plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

D. Modification to supporting structure is not permitted where railing is to be attached.

E. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.

B. Expansion Joints:

1. Maximum intervals of 54 feet on center and at structural joints.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

C. Posts and Rails:

1. Surface Mounted Posts:
 - a. Bolt post baseplate connectors firmly in place.
 - b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
4. Install posts and rails in same plane.
5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

- D. Wall Brackets: Support wall rails on brackets spaced maximum 5 feet on centers as measured on the horizontal projection.
- E. Toeboard:
 - 1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
 - 2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.
 - 3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
 - 4. Install plumb and aligned to within 1/8 inch in 12 feet.
 - 5. Attach toeboards to posts via clamp that complies with design requirements while facilitating expansion and contraction. Do not screw directly to post or base.
- F. Railing System Gate: Install in accordance with manufacturer's installation instructions.

3.03 FIELD FINISHING

- A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Post-installed anchors supporting railing systems require special inspection.
- B. Contractor-Furnished Quality Assurance, in accordance with ICC IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.
- C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 40 00, Quality Requirements.

3.05 CLEANING

- A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
- B. Do not use acid solution, steel wool, or other harsh abrasive.

- C. If stain remains after washing, restore in accordance with railing manufacturer's recommendations or replace stained railings.

END OF SECTION

