SECTION 05520
METAL 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 Iron and Steel Institute (AISI).
3. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   d. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   e. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   f. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   g. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   h. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   i. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
   j. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
4. International Code Council (ICC): International Building Code (IBC).
5. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

A. Handrails: Synonymous with terms; i.e., guardrail system, railing system, ramp-rail system, and stair-rail system. Handrails are comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

B. ICC Evaluation Services Report for concrete anchor manufacturers.

C. Special Inspection: As governed by the ICC IBC.

D. Toe boards: Vertical barrier at floor level usually erected on handrails along exposed edges of floor or wall openings, platforms, ramps, or stairs to prevent miscellaneous items from falling through.

1.03 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Indicate handrail profiles, sizes, connections, anchorage, size and types of fasteners, and accessories. Project-specific scale plans and elevation of handrails and components.
      b. Design Data: Calculations or test data using design performance loads and include the following:
         1) Bending stress in, and deflection of, posts in accordance with ASTM E985.
         2) Stress in post base connection.
         3) Calculation of anchorage forces and comparison of these forces to ICC IBC recommendations regarding safe allowable design loads of anchorages.
         4) For concrete anchor spacing less than 12 anchor diameters and edge distances less than six anchor diameters, make reduction in allowable pullout and shear values. Provide independent laboratory inspection service for ICC Evaluation Services Report values with Special Inspection.

B. Informational Submittals:

   1. Manufacturer's assembly and installation instructions.
   2. Special Inspection:
      a. Manufacturer's instructions for Special Inspection of concrete anchors.
      b. Special Inspection report in accordance with Article Tests and Inspections.

1.04 QUALITY ASSURANCE

A. Qualifications: Calculations required for design data stamped by a registered civil or structural engineer licensed in the State of project location.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handrails adequately packaged and wrapped to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping until railing is completely installed.

B. Aluminum Handrails:

1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.

PART 2 PRODUCTS

2.01 DESIGN PERFORMANCE

A. Structural Performance of Handrails: Design, fabricate, and install handrails 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 each of the respective components comprising handrails.

1. Top Rail of Handrails: Capable of withstanding the following load cases applied:
   a. Concentrated load of 200 pounds applied at any point and in any direction in accordance with ICC IBC.
   b. Uniform load of 50 pounds per lineal foot applied in any direction in accordance with ICC IBC.
   c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with ICC IBC.
2. Mid-rails with corner returns to withstand a 200 pound concentrated vertical load applied at any point or direction without damage and loosening of pipe, fittings, or attachment hardware.
3. Concrete Anchors for Handrail Wall Brackets: Anchors with a strength required by calculations with concrete strength assumed at 4,000 psi and in conformance with ICC IBC.
4. Concrete Anchors: In accordance with ICC IBC for size, length, embedment, spacing, and edge distance to match required loads shown in calculations.

2.02 ALUMINUM HANDRAILS

A. General:

1. Furnish pre-engineered and prefabricated three rail handrails.
2. Pop rivets and glued railing construction not permitted.

B. Rails, Posts, and Formed Elbows: Extruded Alloy 6105-T5 or 6061-T6, minimum tensile strength of 38,000 psi and minimum yield strength of 35,000 psi.

1. Miscellaneous Aluminum Parts: 6063-T6 or 6061-T6 extruded aluminum of adequate strength for all loads.
2. Post and Railing: Nominal 1-1/2-inch diameter.
   a. Rails: 1.900-inch outside diameter by 0.145-inch wall thickness, Schedule 40.
   b. Posts: 1.900-inch outside diameter by 0.200-inch wall thickness, Schedule 80.
   c. Solid dowel interconnectors of 6105-T5 or 6061-T6 aluminum.

C. Fittings:

1. Handrail and Post Fittings: Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements. Fittings shall match color of pipe in handrails. Sand cast parts not permitted.
2. Concrete Top Mount Post Base:
   a. Four holes in base for concrete anchors. For narrow walls or curbs, furnish two holes in base for concrete anchors with required edge distance.
3. Concrete Side Mounted Handrail Bracket: Extruded aluminum, Alloy 6063-T6 with four holes for bolts or concrete anchors.
4. Concrete Anchors for Securing Bases and Brackets to Concrete: Type 304 or Type 316 stainless steel 1/2-inch concrete anchors.
5. Handrail Connections for Metal Stairway Stringers:
   a. Extruded aluminum bracket, Alloy 6063-T6.
   b. Brackets bolts 3/8-inch diameter Type 304 or Type 316 stainless steel bolts.
6. Handrail Connections for Metal Beams:
   a. Extruded aluminum bracket, Alloy 6063-T6.
   b. Bracket bolts 3/8-inch diameter Type 304 stainless steel bolts.
   c. Manufacturers and Products:
7. Handrail Wall Brackets: Adjustable wall fitting, with provision for three 3/8-inch Type 304 stainless steel bolts or concrete anchors.
9. Handrail Gate: 6063-T6, 6105-T5, or 6061-T6 extruded aluminum.
   a. Hardware Manufacturers and Products:

10. Toe boards and Accessories:
    a. Material: Molded or extruded 6063 or 6061 aluminum.
11. Castings for Handrails:
    a. Cast Al-mag with sufficient strength to meet load and test requirements.
    b. Anodizable grade finish with excellent resistance to corrosion when subject to exposure of sodium chloride solution intermittent spray and immersion.

D. Concrete Embedded Metal Anchorages: In accordance with Section 05 50 00, Metal Fabrications.

E. Finishes:

1. Handrail Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
2. Cast Fittings and Toe boards: In accordance with AA DAF45, designation AA-M10-C22-A41.

2.03 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, RHMS Round Head Machine Screws: Type A 304 or Type A316 stainless steel.

B. Bolts and Nuts for Bolting Handrail to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type A 316 stainless steel with minimum yield strength for bolts of 95,000 psi, unless otherwise shown.

C. Concrete Anchors:

1. Stainless steel Type 304 or Type 316.
2. Use ICC IBC approved values for size, length, embedment, spacing, and edge distance to match required loads shown in calculations.

D. Adhesive Anchors:

1. 1/2-inch diameter, minimum, for exterior use only in accordance with Section 05 50 00, Metal Fabrications, as an alternative to mechanical concrete anchors.
2. Design and provide number required.
3. Do not use where fire or elevated temperatures above 120°F exist.

2.04 FABRICATION OF ALUMINUM HANDRAILS

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.

B. Shop/Factory Finishing:

1. Use same alloy for uniform appearance throughout fabrication for railings.
2. Handrail and Post Fittings: Match fittings with color of pipe in handrail.
3. Sand cast parts not permitted.

C. Tolerances:

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

PART 3 EXECUTION

3.01 GENERAL

A. Modification to structure not permitted where handrail is attached.

C. Mount handrails only on completed walls. Do not support handrails temporarily by means not satisfying structural performance requirements.

3.02 HANDRAIL INSTALLATION

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

B. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. 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 the plane of the rail.

C. Setting Posts:

1. Surface Mounted:
   a. Bolt post baseplate connectors firmly in place.
   b. Shims, wedges, grout, and similar devices for handrail post alignment not permitted.

D. Posts and Rails:

1. Set posts plumb and aligned to within 1/8 inch in 12 feet.
2. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.

3. Install posts and rails in same plane. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.

F. Handrail Wall Brackets:

1. Support wall rails on brackets spaced maximum 5 feet as measured on the horizontal projection.
2. Install wall anchor back plates on solid blocking in stud walls.

G. Toe board:

1. Provide at handrails, except where 4-inch or higher concrete curbs are installed or at gates.
3. Dimension between bottom of the toe board and walking surface not to exceed 1/4 inch.
4. Aluminum Toe boards: Provide expansion and contraction connections between each post.
5. Steel Toe boards: Between each post cut toe board and provide slotted holes for expansion and contraction.

H. Railing 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.

3.04 TESTS AND INSPECTIONS

A. Perform Special Inspection for anchors where ICC Evaluation Services Reports require them for anchor strength value used.

B. Provide an independent test laboratory to perform Special Inspection, (if required).

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 manufacturer's recommendations or replace stained handrails.

END OF SECTION