



SECTION 05 52 16 - ROOFTOP GUARDRAIL SYSTEMS

TIPS:

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

[SafePro Roof Hatch Safety Rail and the old RTA Sector guardrail line, including the base]

- A. Section includes the following rooftop guardrail systems:
 - 1. Portable vertical guardrails with ballasted guardrail bases.
 - 2. Movable, non-penetrating pipe & component inward-leaning guardrails with ballasted guardrail bases.
 - 3. Permanent, vertical, penetrating pipe guardrails.
 - 4. Roof hatch guardrails.
- B. Related Requirements:
 - 1. Division 05 Section "METAL RAILINGS" for permanent guardrails.
 - 2. Div. 07 Section "SHEET METAL FLASHING AND TRIM" for coordination of flashing of roof guardrails penetrating roof membranes.

1.03 REFERENCES

- A. Definitions: Definitions in OSHA 29 CFR 1910 and 1926 including their subparts apply to this Section.
 - 1. Guardrail System: A barrier erected to prevent persons from falling to lower levels.
 - 2. Competent Person:
 - a. As defined in 29 CFR 1910.140(b) as "a person who is capable of identifying existing and predictable hazards in any personal fall protection system or any component of it, as well as in their application and uses with related equipment, and who has authorization to take prompt, corrective action to eliminate the identified hazards."
 - 3. Qualified Person:
 - a. As defined in 29 CFR 1910.140(b) as "a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project."

- B. Reference Standards: Perform Work per standards specified and as follows unless modified by requirements in the Contract Documents.
 - 1. American National Standards Institute (ANSI)/The American Society of Safety Professionals (ASSP):
 - a. ANSI/ASSP Z359.6 - Specifications and Design Requirements for Active Fall Protection Systems."
 - b. OSHA 29 CFR 1926, "Safety and Health Regulations for Construction."
 - 1) OSHA 29 CFR 1926, Subpart M "Fall Protection."
 - 2. U.S. Green Building Council (USGBC) - Leadership in Energy and Environmental Design (LEED) (<http://www.usgbc.org/>):
 - a. USGBC-LEED [v4] for [**Building Design and Construction (BD+C)**] [**Interior Design and Construction (ID+C)**] [**Building Operations and Maintenance (O+M)**] [**Neighborhood Development (ND)**] [**Building Design and Construction: Homes and Midrise (BD+C)**] Reference Guide.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate layout and installation of work of this Section with interfacing and adjoining work and other Sections affecting or affected by work of this Section for proper sequencing of each installation.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities; weights; furnished specialties; and accessories.
- B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of guardrail systems, as well as procedures and diagrams.
 - 1. Show complete layout and configuration of guardrail systems including all components and accessories.
 - 2. Clearly indicate design and fabrication details and installation details.
 - 3. Include plans, elevations, sections, details, and attachments to other Work
 - 4. Include installation and rigging instructions and all necessary Restrictive and Non-Restrictive Working Usage Notes and General Safety Notes.
 - 5. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Delegated-Design Submittal: Include design [**data**] [**calculations**] for guardrail systems for which design is assigned to Contractor.
 - 1. Indicate working and ultimate loads for each guardrail system.
 - 2. Indicate design loads imposed on building structure at points of support.

1.06 INFORMATIONAL SUBMITTALS

- A. Manufacturers' instructions for each product.
- B. Field quality control test and inspection reports.
- C. Sustainable Design [**LEED**] Submittals:
 - 1. [**insert requirements or reference to Division 01 Sections as required**]
- D. Qualification Statements for [**manufacturer,**] [**design professional,**] [**welders,**] [**installer**].

1. Include manufacturer's approval for installer.
2. Include list of past Projects and contacts evidencing compliance with specified qualifications.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For guardrail systems to include in operation and maintenance manuals.
1. Requirements for guardrail systems including complete instructions for users and building maintenance personnel for the safe and proper use, operation, **[movement,]** and maintenance of guardrails and their components.
 2. Provisions for pre-operational, operation, and maintenance inspections. Include a Log Book outlining mandatory annual inspection requirements that are in accordance with ANSI and OSHA Regulations and Industry Standards.
 3. Plan view drawing of the building's roof, including the building name and address.
 - a. Show guardrail system layout.
 - b. Identify load ratings of each guardrail system.
 4. **[An Operating Procedures Outline System (OPOS) for all procedures not covered by the California Labor Code orders. Indicate date the OPOS was prepared on isometric or plan view drawing.]**
- B. **[Regulatory agency approvals for use of guardrail systems.]**

1.08 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturer Qualifications: Minimum **[10]** years experience
 - a. Company: One specializing in the design, fabrication and installation of guardrail systems specified in this Section and whose products have a record of successful in-service performance.
 - b. Manufacturer shall maintain specific liability insurance (products and completed operations) in the amount of **[\$2,000,000.00]** to protect against product/system failure.
 2. Installer Qualifications: Minimum **[5]** years experience
 - a. Company: A firm or individual certified, licensed, or otherwise qualified or employed by guardrail systems manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
 - b. Project Experience: Minimum **[5]** years experience on at least **[5]** projects of similar nature in past **[5]** years.
 - c. Staff: Employ a competent foreman who is a Competent Person as defined in 29 CFR § 1926.32(m) and who is a certified installer to supervise Work of this Section. Foreman shall be present whenever Work is in progress.
 3. Welder Qualifications: Welders must be qualified to applicable AWS Standards for each type of weld required.
 4. Design Professional Qualifications:
 - a. Professional engineer **[employed by the guardrail systems manufacturer and]** experienced in design and engineering of guardrail systems and their application and safety requirements, **[licensed] [or] [registered]** in jurisdiction in which Project is located, and who assumes responsibility for the following:
 - 1) Preparation of comprehensive engineering analysis data.
 - 2) Preparation of engineering calculations.
 - 3) Preparation of shop drawings and other submittals.
 - 4) Testing program development.
 - 5) Review and corroborate comments from Architect and other reviewers on delegated-design submittals and address required changes in their design.

- B. Certifications:
 - 1. Inspection certificates **[and use permits]** for guardrail systems.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Delivery Requirements: Deliver materials in manufacturer's undamaged packaging, complete with installation instructions.

1.10 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer agrees to repair or replace components of guardrail systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **<Insert number>** year(s) from date of Substantial Completion:

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products as furnished by the following]**
 - 1. SafePro Safety Products.
 - 2. Substitutions **[will]** **[will not]** be considered. Comply with provisions of Division 01 Section "SUBSTITUTION PROCEDURES."
- B. Project Source Limitations: Obtain each variety of fall protection equipment, whether specified in this Section or in other Sections, through one source from a single manufacturer who is capable of showing prior successful production of units similar to those required for entire Project

2.02 DESCRIPTION

- A. Rooftop guardrail systems consist of the following:
 - 1. Portable vertical guardrails with ballasted guardrail bases.
 - 2. Movable, non-penetrating pipe & component inward-leaning guardrails with ballasted guardrail bases.
 - 3. Permanent, vertical, penetrating pipe guardrails.
 - 4. Roof hatch guardrails.
- B. Product Options: Drawings **[may]** indicate suggested locations[, **profiles, and dimensional requirements]** of guardrail systems and are based on the specific system indicated. Final locations shall be determined according to guardrail system manufacturer's design requirements.
 - 1. If modifications are proposed, submit, with Shop Drawings, comprehensive explanatory data to Architect for review.
- C. Regulatory Requirements: Provide rooftop guardrail systems **[and anchorage]** designed and constructed to suit building configuration and in accordance with the Contract Documents and applicable regulations and codes.
 - 1. Comply with the following OSHA regulations:
 - a. OSHA 29 CFR 1926, Subpart M "Fall Protection."

2.03 PERFORMANCE / DESIGN CRITERIA

- A. Delegated Design: Professional design services are specifically required of Contractor. Engage a qualified design professional to design rooftop guardrail systems using performance requirements and design criteria specified herein.
 - 1. Design Criteria:

- a. Rooftop guardrail systems shall comply with current applicable federal, OSHA, ANSI, and state regulations and standards.
 - b. Design anchorage components, using proper engineering principles, to provide adequate attachment to building; ensure compatibility with industry standard equipment.
 - c. Design permanent rooftop guardrail systems to accommodate structural movement, movement within system, movement between system and support components, dynamic loading and release of loads, and deflection of structural support, without detriment to durability or performance, without damage to support structure.
 - d. Design rooftop guardrail systems and provide clearances that will allow for installation tolerances, and expansion and contraction of adjacent building materials.
2. Structural Performance Criteria: Provide rooftop guardrail systems[, **including anchorages,**] complying with specific performance and design criteria indicated, capable of withstanding, without failure, the effects of gravity loads and in-use loads and stresses under conditions indicated or reasonably anticipated. Include necessary modifications to meet required criteria.
- a. Contract Documents may indicate certain performance requirements, features, and primary components required, but do not cover details of design and construction, and do not purport to identify nor solve problems of thermal or structural movement[, **anchorage,**] or moisture disposal. Requirements shown by details are intended to establish basic locations and dimension of rooftop guardrail systems.
 - b. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
 - c. Compliance with requirements of authorities having jurisdiction is the responsibility of Contractor.

2.04 GUARDRAILS

- A. Design Criteria: Design for the following:
1. Top rail 42 inches high and capable of withstanding a load of at least 200 lbf (0.89 kN) applied in any direction at any point.
 2. Midrail at 21 inches high and capable of withstanding a force of at least 150 lbf (0.67 kN) applied in any downward or outward direction at any point.
- B. Portable Guardrail System: **[29 CFR 1910.29(b)] [Cal-OSHA §3209]** compliant, free-standing, non-penetrating, counterweighted, 42 inch high guardrail system to prevent falls from open sides of roof including railing sections and ballasted bases required for a complete installation.
1. Basis of Design Product: Portable Guardrail Panels by SafePro Safety Products.
 2. Supports every **[10 feet (3048 mm)] [8 feet (2438 mm)] [5 feet (1524 mm)]**.
 3. Maximum Assembled System Weight: Not more than 5 psi (34 kPa) at bases.
 4. Counterweighted Guardrail Bases: Cast iron with three off-centered stanchion receiver sockets.
 - a. Nominal Size: 24 inch deep by 18 inch wide by 2-1/2 inch high (609 mm deep by 457 mm wide by 64 mm high) design to prevent water ponding. Cast or smooth edges to prevent damage to roof.
 - b. Finish: Galvanized.
 5. Roof Protection Pads: **[1/4 inch (12.7 mm)]** thick, resilient pad larger than bases and compatible with roof membrane. **[Scrap roof membrane may be used for protection if approved by roof system manufacturer.]**
 6. Tubing: ASTM A 500/A500M, Galvanized
 - a. Rail Units: Single length pipe top rail bent into inverted U with factory welded midrail.
 - b. Finish: **[Hot-dip galvanized] [Manufacturer's standard powdercoat finish in color as selected from manufacturer's standards]**.
 7. Gates: Self-closing swing gates where indicated. Match railing materials and finish.
- C. Pipe & Component Guardrail System: **[29 CFR 1910.29(b)] [Cal-OSHA §3209]** compliant, free-standing, contoured, inward-leaning non-penetrating, counterweighted, 42 inch high guardrail system to

prevent falls from open sides of roof including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation.

1. Basis of Design Product: Contoured Pipe & Component Guardrail System by SafePro Safety Products.
2. Counterweighted Guardrail Bases: Cast iron with three off-centered stanchion receiver sockets.
 - a. Nominal Size: 24 inch deep by 18 inch wide by 2-1/2 inch high (609 mm deep by 457 mm wide by 64 mm high) design to prevent water ponding. Cast or smooth edges to prevent damage to roof.
 - b. Finish: Galvanized.
3. Roof Protection Pads: **[1/4 inch (12.7 mm)]** thick, resilient pad larger than bases and compatible with roof membrane. **[Scrap roof membrane may be used for protection if approved by roof system manufacturer.]**
4. Tubing: ASTM A 500/A500M, Galvanized
 - a. Rail Units: Single length pipe; vertical supporting posts bent inward away from roof edge.
 - b. Finish: **[Hot-dip galvanized] [Manufacturer's standard powdercoat finish in color as selected from manufacturer's standards].**
5. Fittings: Manufacturer's standard cast metal alloy, elbows, tees, crossings, and other types to suit application.
6. Gates: Self-closing swing gates where indicated. Match railing materials and finish.

- D. Permanent Penetrating Guard Railing System: See Div. 05 Section **["METAL RAILINGS."]** **["PIPE AND TUBE RAILINGS."]**

[***OR*****]**

- E. Permanent Penetrating Guard Railing System:
1. Tubing: ASTM A 500/A500M, Galvanized.
 2. Base Bracket: Galvanized steel plate pre-punched for screw attachment **[through metal roof deck] [into concrete deck]** with post socket bolted or welded to base plate. Design to allow application of roof membrane patch for water tight seal.
 3. Finish of Component Parts: **[Galvanized] [Manufacturer's standard powdercoat finish in color as selected from manufacturer's standards].**
- F. Roof Hatch Guardrails: **[29 CFR 1910.23(a)(2) and 29 CFR 1910.29(b)] [Cal-OSHA §3212 and §3209]** compliant system to protect open sides of roof hatch opening including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation. Designed for attachment to roof hatch curb with no roof membrane penetrations.
1. Basis of Design Product: SafePro Roof Hatch Fall Protection Safety Rail
 2. Height: Not less than 42 inches above finished roof deck when mounted on roof hatch cap flashing.
 3. Posts and Rails: ASTM A 500, galvanized-steel tube, round, 1-1/4 to 1-5/8 inch size.
 4. Self-Closing Gate: Fabricated of same materials and rail spacing as safety railing system. Provide non-corrosive metal, self-closing, hinges opening gate away from hatch ladder. Gate shall be designed with two horizontal rungs suitable for climbing support.
 5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 6. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 7. Fabricate joints exposed to weather to be watertight.
 8. Fasteners: Stainless steel, through-bolted to curb.
 9. Finish: **[Manufacturer's standard powder coat finish] [Hot-dip galvanized and unpainted].**
 - a. Color: **[Safety yellow] [Custom color as selected].**
- G. Toe Boards: Provide toe boards at railings around openings and at edge of open-sided roofs, floors, and platforms. Fabricate to 4 inch height above adjacent surface with no more than a 1/4 inch gap at the bottom.

Guardrails for mounting to walls and parapets are also available. Contact SafePro Safety Products for more information and details.

2.05 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A 36M.
- B. Steel Pipe: ASTM A53/A 53M, Standard Weight (Schedule as indicated) unless otherwise indicated.
- C. Steel Tubing: ASTM [A1085] [or] [A500] [or] [A1065], cold-formed [Hollow Structural Sections (HSS)] [steel tubing].
- D. [Cast Iron]: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- E. [Cast Aluminum]: ASTM B 26/B 26M, Alloy A356.0-T6.
- F. [Cast Aluminum/Magnesium Alloy]: ASTM B 686.

2.06 FASTENERS

- A. General: Select fasteners and anchors for type, grade, and class required. Unless otherwise indicated, provide fasteners as follows:
 - 1. Material for exterior [and interior] locations in contact with aluminum: Type [304] [316] stainless-steel fasteners.
 - 2. Material for exterior locations exposed to weather: [Type [304] [316] stainless steel fasteners] [hot-dip galvanized fasteners per ASTM F2329].
 - 3. Material for interior locations or where built into exterior walls or below roof flash point: [Hot-dip galvanized fasteners per ASTM F2329.] [Zinc-plated fasteners with coating per ASTM B 633, Class Fe/Zn [5] [8] [12] [25] Service Class.]
- B. Stainless Steel Bolts and Nuts: ASTM F593 [regular] [heavy] hexagon-head annealed stainless steel bolts; with ASTM F594 hex nuts; and, where indicated, flat washers; Alloy [Group 1] [Group 2].
- C. Stainless Steel Washers: ASTM A240/A 240M, [Type 304] [Type 316] and ANSI B18.22.1, Type A Plain.
- D. High-Strength Steel Bolts and Nuts: ASTM A325, Type 3 regular hexagon-head bolts; with ASTM A563, Grade C3 hex nuts; and, where indicated, flat washers.
- E. Steel Bolts and Nuts: ASTM A307, Grade A regular hexagon-head bolts; with ASTM A563 hex nuts; and, where indicated, flat washers.
- F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors designed for and recommended by anchorage manufacturer for conditions encountered.

2.07 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.08 FABRICATION

- A. Factory fabricate portable guardrail sections to include top rail bent downward to form two upright posts with a midrail welded between the uprights.
- B. Factory fabricate roof hatch guardrail units to protect four sides of hatchway. Include sides with top rail bent downward to form two upright posts with midrails at each side of hatchway welded between the uprights. Bend uprights inward at bottom to attach to vertical sides of hatch base without penetrations into hatch flashing or roof. Include a toprail bolted between the uprights at rear (hinge side) of hatch. Include a self-closing gate at front of hatchway doubling as two additional ladder rungs designed to allow climbing use for a person exiting the hatch.

2.09 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Pigmented Organic Finish: Manufacturer's standard **[powder coat]** comparable in performance to AAMA 621 coatings.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: **[High visibility yellow] [As selected from manufacturer's full range]**.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Examine roof and other mounting surfaces for suitable conditions where guardrail systems will be installed for compliance with requirements for operational clearances and other conditions affecting performance of work.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate location of guardrail systems indicated to be permanently attached to structure or roofing system and provide appropriate anchoring devices with installation templates, diagrams, and manufacturer's instructions.

3.03 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions and recommendations, referenced standards, requirements of authorities having jurisdiction, and approved submittals.
- B. Install products in place to obtain the required working loads without exceeding allowable loads for each guardrail system.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where fall protection devices are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

1. Install fasteners in accordance with fastener manufacturer's recommendations to obtain the allowable working loads published in their product literature.
2. **[Apply thread-locking fluid or deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.]**

- D. Coordinate installation of flashed roof anchorage with roofing trades to ensure a roofing manufacturer-approved, water-tight flashing method is used.

3.04 REPAIR

- A. Repairing Damaged Finishes: Immediately after installation, clean abraded and other areas where coatings are damaged.
1. Galvanized Surfaces: Clean bolted connections and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
 2. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish per manufacturer's written instructions.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
1. Require product manufacturers to provide field surveillance of the installation of their products.
 2. Monitor and report installation procedures, and unacceptable conditions.
 3. Engage manufacturer's Qualified Person to perform field tests and inspections and to prepare test reports.
- B. Testing Services: Testing and inspecting of completed applications of guardrail system work shall take place in successive stages as guardrail systems are installed. Do not proceed with work for the next area until test results for previously completed applications of work show compliance with requirements.
1. Prepare a written report to Contractor with copy to Architect and Owner including the date and results of the inspection, the signature of the person who performed the inspection, and the number, or other identifier, of the building support structure and equipment which was inspected.
- C. Do not load or stress system until materials and fasteners are properly installed and ready for service.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 PROTECTION

- A. Protect roof surfaces from damage during installation.

END OF SECTION 05 52 16