

HORIZONTAL TROLLEY RAIL SYSTEMS

MAINTENANCE EQUIPMENT
window washing systems

11010
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Pro-Bel Enterprises
Limited



PRO+BEL

Safety Systems Engineered for Life



SUSPENDED EQUIPMENT & FALL PROTECTION EXPERTS

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Window Cleaning/
Suspended Maintenance
Equipment & Fall
Protection Systems

DESCRIPTION

When workers require horizontal mobility when working or rigging close to an unprotected vertical drop (narrow roof), multiple single point anchors or horizontal cable may be economically or structurally impractical when considering the attachment of worker's lanyards, lifelines, and rigging lines. The solution is a fully engineered Pro-Bel Horizontal Trolley Rail lifeline system offering continuous protection. Secured to the building at 10'-0" to 12'-0" (3050 mm to 3658 mm) centers (see Design Considerations on page HR-5), rails are available in aluminum or steel and may be straight or radiused.

Trolley rails differ from horizontal cable lifeline systems (see Pro-Bel Horizontal Cable Lifeline Systems literature) in that trolley rails are considered a non-restrictive* fall protection system. Unlike cable systems, trolley rails are designed and engineered for multi-purpose application, including:

- restraint lanyards;
- fall arrest lifelines;
- direct rigging or attachment of primary suspension lines when rigging a bosun's chair with descent control equipment;
- attachment of tie-back lines when using outrigger beams or parapet wall clamps (stage, cage or bosun's chair).

In addition, trolley rails are not subject to the same amplified loads as cable systems since the loads are distributed more evenly via rails, supports and structure.

Pro-Bel offers several types of trolley rail systems. Each has been engineered to satisfy a particular job requirement. They can be categorized as follows:

1. *Aluminum Horizontal Trolley Rail:* an extruded aluminum rail which houses a traversing trolley assembly along one side of the rail. Advantages include light weight and ease of installation.
2. *Steel Horizontal Trolley Rail:* a steel beam section available with a trolley assembly on one side or both sides of the rail.

Both of the above category rails are supplied complete with roof or other type supports or securements.

In all cases, workers secure their lines to a U-bar trolley assembly. Any number of trolley assemblies may be specified for use on rails.

*The intent of OSHA is to provide safety guardrails at narrow roof areas (a non-restrictive fall protection system). Horizontal trolley rail systems are still considered a restrictive system and will require the implementation of specific work procedures.



Roof mounted horizontal aluminum rail. Photo shows worker preparing to work over parapet. Both lines are secured to rolling trolleys. Parapet to support 1800 lbs (7.9 kN) vertical load.



Pier mounted horizontal steel rail with rolling trolleys provides continuous horizontal movement for workers. Yellow lanyard restricts travel to inside of the low parapet which is less than 42" (1067 mm) guard rail height. Safety anchors at base of air duct are used to secure bosun's chair suspension line and separate lifeline.



This unusual penthouse roof mounted rail is equipped with yokes for securing the inboard ends of long reach outrigger beams. The working ends of the outriggers are supported on a high parapet wall (not shown). Rolling trolleys inside the rail are used for workers' lifelines.



View of penthouse roof in photo at left shows rail support piers located at 10'-0" to 12'-0" (3050 mm to 3658 mm) centers. Black walkway strip on roof protects single ply roof membrane from roof traffic i.e. window cleaners or other maintenance personnel.

USE

For horizontal mobility over extended distances while working close to a vertical drop e.g. within 6'-0" (1830 mm) of the roof edge (OSHA 1926.502), or any high, narrow, level roof area or walkway.

Ideal for long restricted spaces or tight quarters for securing a lanyard or a lifeline, direct rigging, or for the tie-back of an outrigger or parapet wall clamp.

As an alternative to single anchor points when independent anchors do not provide the required degree of safety.

As a complement to conventional vertical lifeline anchorages in or around confined spaces, clerestory areas, ledges, narrow roof spaces, cornices, or to provide a safe means of access to, and egress from, work zones i.e. once at a work zone, the worker can tie off to a separate fall protection system and/or access primary equipment.

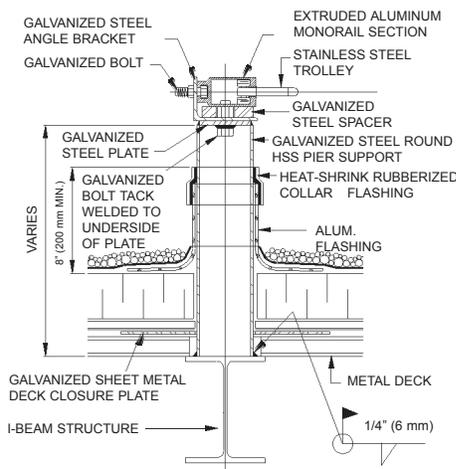
FEATURES

All corrosion resistant materials; trolley rail components are stainless steel, hot dipped galvanized steel and aluminum.

Standards conformance; all trolley rails comply with OSHA and ASME/ANSI/IWCA safety requirements for window cleaning, and various materials standards.



Terminal end of aluminum rail showing stop in foreground and trolleys in background.



SECTION DETAIL - HORIZONTAL TROLLEY RAIL

Installation flexibility; Pro-Bel Horizontal Trolley Rail Systems are suited to a broad range of building structures, including concrete, structural steel or precast panels. Securement methods include cast-in-place, through bolts, bolt around, welding, or chemical adhesive fastening.

Engineer certified; OSHA requires that trolley rail devices be designed by or under the direction of a registered professional engineer experienced in such design. Pro-Bel trolley rail performance is based on data derived from independent testing and/or engineering calculations.

Compatible with roofing; an important consideration in the design of Pro-Bel systems is the need to maintain the long term watertight integrity of the building. Pro-Bel products are designed with a full understanding of reliable flashing/sealing techniques to satisfy virtually any roof condition.

Sole responsibility; Pro-Bel provides complete fall protection products/systems from concept to the supply and installation of same, including annual inspection.

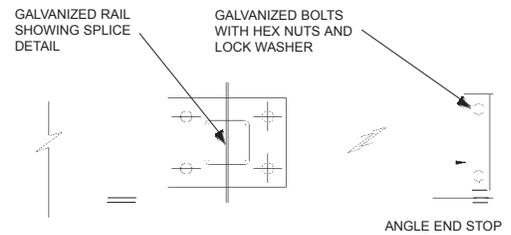
Specific liability insurance; all Pro-Bel installations automatically carry \$5,000,000.00 + coverage against product/system failure (over 5000 projects successfully completed to date).



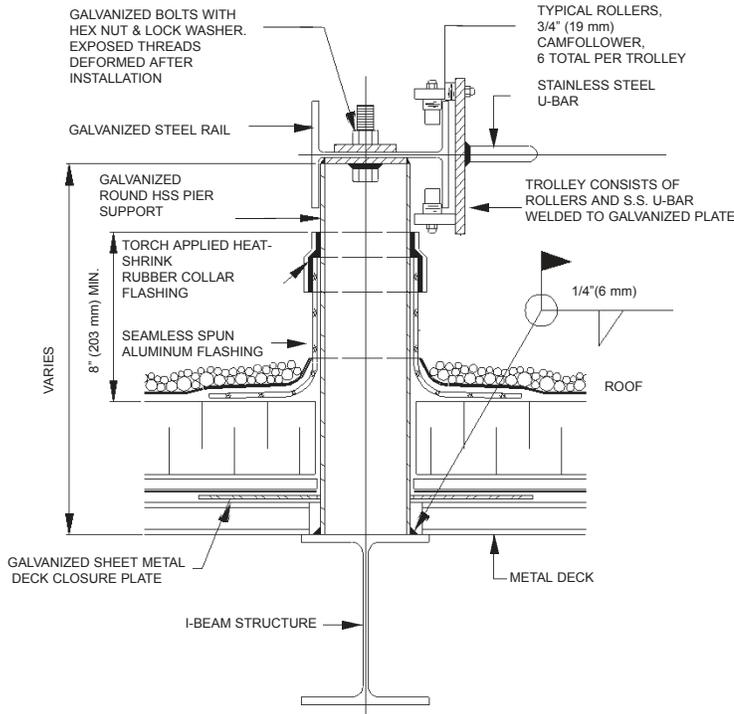
Pier mounted steel rail showing trolleys consisting of rollers, S.S. U-bar and T-type lock.

MATERIAL & FINISH NOTES

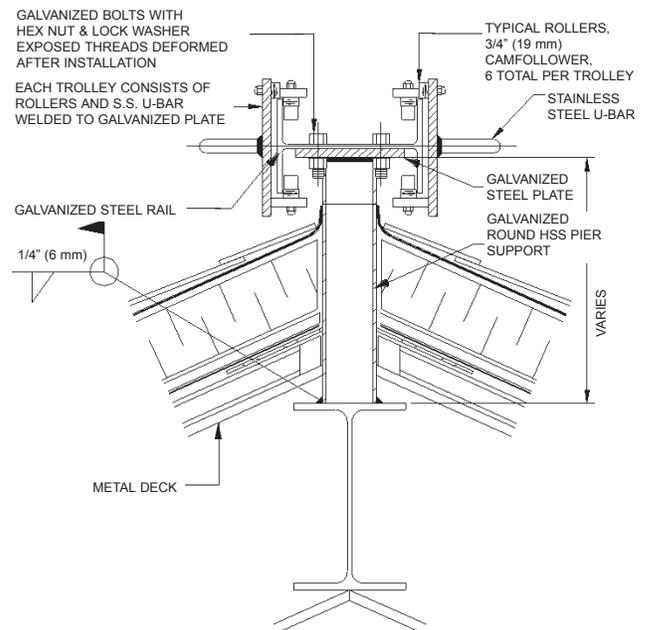
1. Aluminum rails are more easily transported onto roof than steel rails (no special hoisting equipment is required). Clear anodized mill finish is standard. Optional decorative color finish is available.
2. Steel rails are similar to aluminum horizontal trolley rails except they are comprised of much heavier I-beam sections. While steel is less expensive than aluminum, it is more labor intensive to transport and install. Steel rail systems are available with a trolley assembly on one side or both sides of the rail i.e. for a double sloped atrium roof or cupola (see below) or similar applications where access to both slopes is required. Galvanized finish is standard. Optional decorative finish is available.



PLAN VIEW – STEEL RAIL TERMINAL DETAIL



SECTION DETAIL – STEEL HORIZONTAL RAIL (Trolley One Side)



SECTION DETAIL – STEEL HORIZONTAL RAIL (Trolley Both Sides)

MATERIALS/FABRICATION (as applicable)

Rail: aluminum extrusions to ASTM B221-2000 "Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes."

or

Cold rolled steel I-beam sections, Type 300W with yield strength of 44 Ksi (300 MPa) and tensile strength of 65 Ksi (450 MPa), galvanized to ASTM A123/A123M-2002 "Standard Specification for Zinc (Hot-Dip Galvanized Coatings on Iron and Steel Products").

Rail system entry points are equipped with a prominently displayed, non-corrosive data plate clearly stating Maximum Service Capacity, Pro-Bel Enterprises Limited Name, Serial No., and Date of Manufacture.

Trolleys: Type 304 stainless steel complete with stainless steel U-Bar safety anchor(s) and heavy duty rollers.

Roof Supports: hollow steel section (HSS), Type 350W with yield strength of 50 Ksi (350 MPa) galvanized to ASTM A123/A123M-2002.

Plate and all other sections: galvanized mild steel as above with yield strength of 44 Ksi (300 MPa).

Seamless spun aluminum flashing (for roof-type supports): Type 6061-T6 alloy to ASTM B221-2000 with deck flange flashed in using felt plies to NRCA or CRCA recommendations or roofing membrane manufacturer's instructions, as applicable.

Top of support sealing: torch applied heat-shrink rubber collar flashing.

Bolts, nuts and washers: Type 304 stainless steel or steel to ASTM A325.

DESIGN CONSIDERATIONS

Long span support applications: if it is necessary or desirable to locate rail supports at greater than 12'-0" (3658 mm) centers, it is possible to use large structural steel I-beam rail sections. However, steel rails have the disadvantages of added weight and more costly handling and installation.



Photo shows a Pro-Bel ridge mounted type of trolley rail designed for the maintenance of a peaked roof. Worker's safety lifeline is secured to a stainless steel U-bar trolley located either side of the rail. The worker or several workers are able to traverse horizontally to any point on the roof, W.S.U. Physical Plant, Washington State University. Inset is product design photo of trolley rail.



Rail mounted Pro-Bel trolley system at base of windows in this 40th floor Tower application is used to secure workers' fall protection lanyards enabling service to any part of narrow roof areas. Enron Building 2, Houston Texas.

Roof space: Safe access to a trolley rail on narrow roof areas requires continuous tie-off to the rail. Special rigging provisions must be considered because trolleys are not detachable at drop locations. Provisions may include the following:

- System design for ground rigging using a suspended platform or single work cage with additional trolleys for lanyard attachment for rigging entry and exit access.

- System design to include a winch-type access trolley so that workers can retrieve trolley after "drop" procedure.

Free design service: The selection of fall protection equipment is a performance oriented and highly specialized area requiring an in-depth knowledge of rigging methods, safety and OSHA Standards/State Codes. Pro-Bel provides a free design service to ensure that Pro-Bel products/systems are properly specified.

TROLLEY RAIL LAYOUT PROCEDURE

1. Briefly review the Pro-Bel **System & Equipment Introduction literature (pages G-6 to G18)**. This data provides an overview of the various equipment options used to clean windows or perform other suspended building maintenance.
2. Identify all areas that require trolley rail access. Mark all locations including windows on architectural plans.
3. Examine building elevations or other drawings to identify any unusual features.
4. Examine building section details to assess construction of parapet wall, mechanical room wall, exterior walls, roof assembly or other building elements as necessary.
5. Examine roof or other type structural drawings for possible anchorage locations. Typically rails, steel piers, steel

posts or similar devices are anchored to structural concrete walls or slabs, steel superstructure, or similar elements.

6. Review the Design Considerations on page HR-5 to assist in making a "rigging" decision.

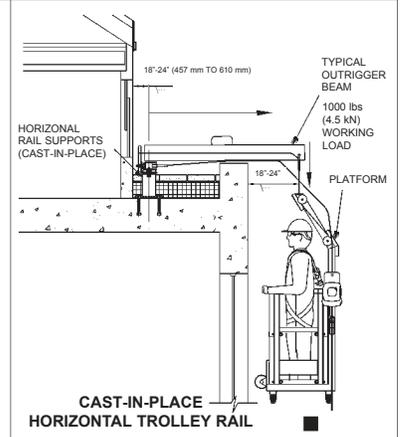
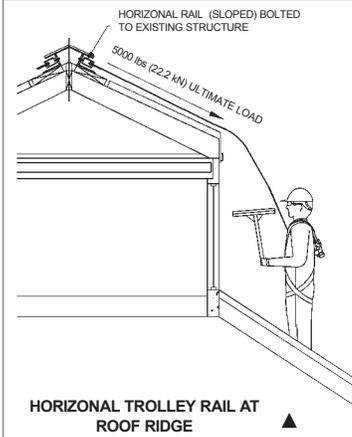
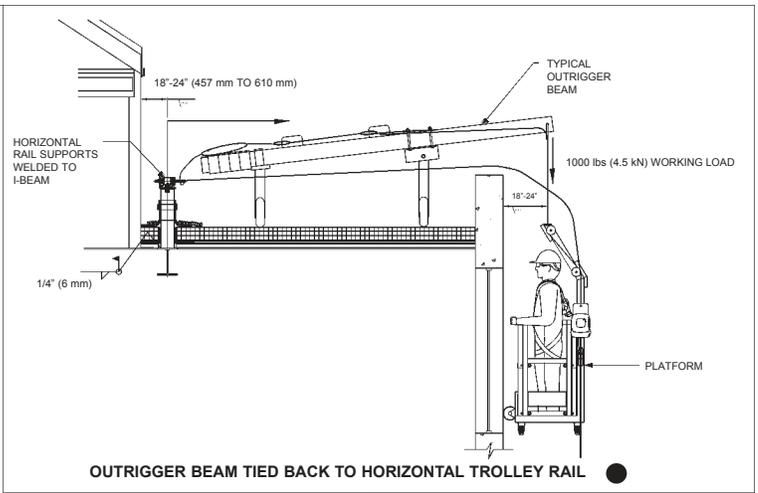
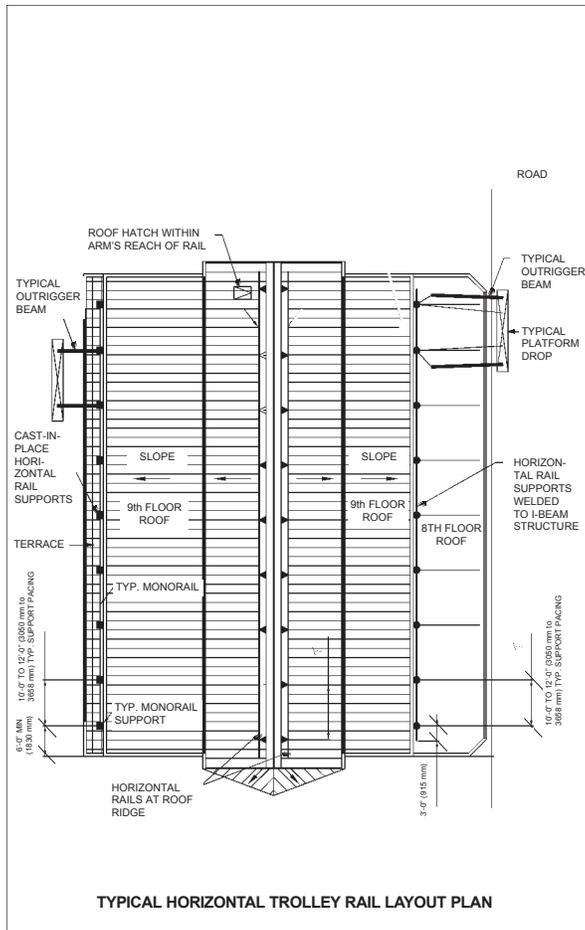
7. Determine where system entry and exit points are to be located and ensure that personnel achieve 100% fall protection at all times.

8. Locate rail anchor points at 10'-0" to 12'-0" (3050 mm to 3658 mm) centers for the respective horizontal rail system selected. Also see Design Considerations on page HR-5.

9. For additional information/options relating to Pro-Bel U-bar anchors or steel pier securement details, refer to Pro-Bel Safety & Tie-Back Anchors literature.

10. If, in addition to horizontal movement (fall protection access), vertical access is required to clean windows using a bosun's chair with descent control equipment, the design should consider including a winch-type access trolley so that worker can retrieve trolley after "drop" procedure. Additionally, if vertical access is required for caulking, metal polishing or other building maintenance using a suspended platform or single work cage, the system design should include additional trolleys for lanyard attachment to allow for safe set up and entry/exit access.

Note: Trolley rails are typically oriented to accommodate horizontal forces. In instances where imposed loads are vertical or create an uplift force, imposed loads will need to be reviewed and additional lifelines and tie-back anchor points will need to be considered.



SPECIFICATION

SPEC NOTE: This basic guide specification (Section 11010 - Window Washing Systems) is devoted exclusively to horizontal trolley rails and is written in accordance with the CSI/CSC Three Part Section Format. It must be adapted to suit the requirements of individual projects. If other equipment such as davits, outrigger beams, rigging sleeves, horizontal cable lifelines or other equipment is required, refer to appropriate Pro-Bel literature and incorporate materials and/or other clauses as required. Square brackets [] indicate choice, alternatives, data required or need for the specifier to make a decision.

PART 1 - GENERAL

- 1.01 General Requirements
- A. Comply with the conditions of the Contract and Division 1 - General Requirements.
- 1.02 Section Includes
- A. Work of this section includes the design, supply and installation of window cleaning/suspended maintenance equipment.
- 1.03 Related Sections
- A. Unloading and hoisting of equipment to roof Section [01500]
B. Cast-in-place concrete, including installation of embedded items Section [03300]
C. Precast concrete Section [03400]
D. Structural Steel Section [05120]
E. Open Web Steel Joists Section [05210]
F. Metal Deck Section [05310]
G. Catwalks Section [05516]
H. Roofing Section [07500]
I. Flashing Section [07600]
J. Sealants Section [07900]
K. Rigging access doors in walls Section [08111]
L. Continuous track stabilization on exterior of building Section [08800]
M. Installation of intermittent stabilization on exterior of building Section [03450]
N. Hot & Cold water supply, faucets and drain at [every] roof level Section [15400]
O. Three phase 208 volts, 60 Hertz service at [every] roof level Section [16050]
- SPEC NOTE: Re 1.03.P. Specify independent protected main line power and weatherproof Hubbell twist-lock 208 volts, 3 phase, 60 Hertz, 30 amperes receptacle (HBL2620SW, NEMA No. L6-30R for rental powered platforms). Power to be located no more than 100'-0" (30 m) from window cleaning/suspended maintenance equipment location. Outlets to experience no more than 3% voltage drop under full load. Pro-Bel wall or roof anchors may be employed for strain relief. Contact Pro-Bel for requirements.*
- P. Weatherproof power supply outlets with strain relief anchors Section [16132]
- 1.04 References
- A. AISC S342L-1993, with Supplement No.1 "Load and Resistance Factor Design Specification for Structural Steel Buildings".
B. AISI SG-971-1996, with 2000 Supplement "Specification for Design of Cold-Formed Steel Structural Members".
- C. Aluminum Association AA ADM-1-Aluminum Design Manual, 2000 and AWS D1.2-97 Structural Welding Code - Aluminum.
D. AWS D1.1-2000 Structural Welding Code - Steel.
E. ANSI/IWCA I-14.1-2001 Window Cleaning Safety Standard (International Window Cleaning Association).
- 1.05 Design Requirements
- A. Design window cleaning/suspended maintenance system to suit building and in accordance with plans, specifications, standards, and regulations/codes contained in section 1.04 and 1.08.
B. Locate horizontal rails to suit lanyard attachment, lifelines, and, suspension equipment which will be used on the building with respect to items such as rigging, spacing, roof edge condition and similar items.
C. Design all anchor components to provide adequate attachment to the building and suited to current window cleaning/suspended maintenance practices. Ensure compatibility with industry standard equipment.
D. Ensure all anchor components conform to proper engineering principles and have been designed by a Professional Engineer qualified in the design of window cleaning/suspended maintenance equipment, its application and safety requirements.
E. Design system equipment supports and fall arrest safety anchors to comply with the following structural requirements:
1. Supports for Suspended Platforms: davits, rigging sleeves and monorails are used for suspending a powered platform from storage and rigging/working locations on the building. These supports and the structure to which they are attached are designed to a typical hoist capacity of 1000 lbs (4.45 kN) plus impact with a factor of safety as per AISC requirements and/or ACI or other applicable construction codes, and to 4 times the rated hoist capacity against fracture or detachment (i.e. a 4 to 1 stability factor).
2. Fall Arrest Safety Anchors: designed to a typical maximum fall arresting force of 1800 lbs (8.0 kN) when wearing a body harness with a factor of safety of 2 without any permanent deformation and to 5000 lbs (22.2 kN) against fracture or detachment.
- 1.06 Shop Drawings and Engineering Certification
- A. Submit shop drawings showing complete layout and configuration of complete window washing/suspended maintenance system, including all components and accessories. Clearly indicate design and fabrication details, window "drops", hardware, and installation details.
B. Shop drawings to include installation and rigging instructions and all necessary Restrictive and Non-Restrictive Working Usage Notes and General Safety Notes.
C. Shop drawings to be reviewed by a professional engineer, and upon request, complete with calculations or test reports.
- 1.07 Qualifications
- A. Manufacturer: Work of this Section to be executed by manufacturer specializing in the design, fabrication and installation of window cleaning/suspended maintenance systems having a minimum of 5 years documented experience.
B. Loading and safety assurance: Work of this Section to meet the requirements of governing codes and jurisdiction and to comply with properly engineered loading and safety criteria for the intended use.
C. Insurance: Manufacturer to carry specific liability insurance (products and completed operations) in the amount of \$5,000,000.00 + to protect against product/system failure.
D. Welding to be executed by welders certified in accordance with AWS requirements.
- 1.08 Regulatory Requirements
- SPEC NOTE: Re 1.08.A. Specify for all States other than New York and California.*
- A. Comply with the following OSHA regulations:
1. 1910, Subpart D (Walking and Working Surfaces).
2. Appendix C to 1910 (Personal Fall Arrest Systems).
3. "OSHA Ruling on Window Cleaning by Bosun's Chair" Memorandum to Regional Administrators from P. K. Clark, Director, Directorate of Compliance Programs.
4. 1910, Subpart F (Powered Platforms).
SPEC NOTE: Re 1.08.B and 1.08.C. Specify for New York State or California only as applicable.
- B. Comply with the following New York State regulations:
1. Department of Labor Advisory Standard 101 - Construction, Operation and Maintenance of Suspended Scaffolds Used for Window Cleaning and Light Maintenance.
2. Advisory Standard 111 - Hoisting Machines Used for Suspended Scaffolds.
3. Department of Labor Industrial Code Rule 21 - Protection of Persons Employed at Window Cleaning - Structural Requirements, Equipment and Procedures.
C. Comply with the following California State regulation:
1. Code of Regulations, Title 8 - Industrial Relations, Article 5 (Window Cleaning), Article 6 (Powered Platforms for Exterior Building Maintenance), and Appendix C to Article 6 (Personal Fall Arrest System).
- 1.09 Maintenance Data
- A. Submit 1 copy of system Equipment Manual & Inspection Log Book, with "Initial Inspection - Certification for Use" and "Inspection Sign-Off" forms completed.
B. Submit 2 copies of a reduced plastic laminated as-built shop drawing showing equipment locations and details. This drawing is to be posted near exits onto the roof.



PART 2 - PRODUCTS

2.01 Manufacturer

- A. This specification is generally based on systems currently being manufactured by PRO-BEL ENTERPRISES LTD., Toll free: 1-800-461-0575. Telephone: 905-427-0616, Fax: 905-427-2545, info@pro-bel.ca.
- B. Other manufactured products meeting this specification may be substituted provided that manufacturers show proof of product insurance. Equipment details to be approved by the architect and/or consultant. Companies, such as miscellaneous metal fabricators, who are not normally engaged in the design and manufacture of window washing equipment are not permitted to bid.

2.02 Equipment

SPEC NOTE: List type and quantity as required.

- A. [_____]
- B. [_____]
- C. [_____]

2.03 Materials

SPEC NOTE: Delete items not required.

- A. Horizontal rails and mounting: designed to carry minimum vertical service load of 1,000 lbs (4.5 kN); fabricated using [aluminum extrusions to ASTM B221-2000 "Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes"] [Cold rolled steel sections, Type 300W with yield strength of 44 Ksi (300 MPa) and tensile strength of 65 Ksi (450 MPa), galvanized to ASTM A123/A123M-2002 "Standard Specification for Zinc (Hot-Dip Galvanized) of Coatings on Iron and Steel Products"].
- B. Monorail finish: exterior finish to be [mill] [anodized] [galvanized] [polyester or polyurethane powder coated baked enamel of color as selected from manufacturer's standard colors or custom color]. Interior finish to be [epoxy] [hybrid powder coated] [enamel painted on site].
- C. Capacity/Data plates: rail entry systems to be equipped with prominently displayed, non-corrosive plate clearly stating Maximum Service Capacity, Manufacturer's name, Serial No. and Manufacturing Date.
- D. Trolleys: two per rail, equipped with heavy duty rollers and 5/8" (16 mm) diameter U-bar

safety anchors; [exterior finish to be Type 304 stainless steel.] [Interior finish to be powder coated mild steel to match monorail.]

- E. Safety U-bars: [Type 304 stainless steel with yield strength of 35 Ksi (240 MPa)] [mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot-dip galvanized to ASTM A123/A123M-2002]. U-bar to be not less than 3/4" (19 mm) diameter material with 1-1/2" (38 mm) eye opening.
- F. Securement bolts: mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot-dip galvanized to ASTM A123/A123M-2002.
- G. Hollow steel section (HSS) piers: galvanized steel as above with yield strength of 50 Ksi (350 MPa). Wall thickness to suit application.
- H. Tethers: All pins and loose pieces to be secured using 1/8" (3 mm) stainless steel cable complete with easily inserted lead connectors to avoid loss.
- I. Base plate and all other sections: galvanized mild steel as above with yield strength of 44 Ksi (300 MPa). Thickness and securement to suit application.

SPEC NOTE: Re 2.03.J. Specify aluminum flashing for BUR or modified bitumen roofs only (membrane above or below insulation). For single ply roofs, flashing to be in accordance with membrane manufacturer's instructions.

- J. Seamless spun aluminum flashing (for roof mounted steel pier anchors): Type 6061-T6 alloy to ASTM B221-2000 with deck flange flashed in to NRCA or CRCA recommendations. Seal top of aluminum flashing with conformable mastic tape and torch applied heat-shrink rubber collar flashing.
- K. Miscellaneous bolts, nuts and washers: mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot-dip galvanized to ASTM A123/A123M-2002 or Type 304 stainless steel with yield strength of 35 Ksi (240 MPa).

2.04 Fabrication

- A. General:
 1. Fabricate work true to dimension, square, plumb, level and free from distortion or defects detrimental to appearance and performance.
 2. Grind off surplus welding material and ensure exposed internal corners have smooth lines.
- B. Horizontal rails:
 1. Design trolleys to run freely under load with minimum manipulation.
 2. Provide end stops to ensure trolleys can-

not become detached from the rail. Stops to be removable for service.

PART 3 - EXECUTION

3.01 Examination

- A. Examine surfaces and areas upon which the work of this Section depends. Report to the Contractor in writing, defects of work prepared by other trades and other unsatisfactory site conditions which would cause defective installation of products, or cause latent defects in workmanship and function.
- B. Verify site dimensions.
- C. Commencement of work will imply acceptance of prepared work.

3.02 Installation

- A. Install equipment in accordance with approved shop drawings and manufacturer's recommendations.
- B. Co-ordinate installation with work of related trades.
- C. Install all work true, level, tightly fitted and flush with adjacent surfaces as required.

SPEC NOTE: Re 3.02.B. In Roof Section [07500], specify all roof mounted rail bases to be properly flashed in compatible with roofing.

SPEC NOTE: Re 3.02.D. Specify for furnish only projects if required.

- D. Manufacturer to assist and/or supervise installation of window cleaning/suspended maintenance equipment installed by others.
- E. Structural steel to receive rooftop rail supports having 4" (100 mm) diameter HSS pier to have minimum 5" (127 mm) wide bearing surface to ensure 100% weld.

3.03 Final Adjusting and Inspection

- A. Adjust and leave equipment in proper working order.
- B. Complete "Initial Inspection - Certification for Use" form included in Equipment Manual & Inspection Log Book.

3.04 Testing

- A. All anchorage systems relying upon chemical adhesive fasteners to be 100% tested on site using load cell test apparatus in accordance with manufacturer's recommendations.

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