



HORIZONTAL CABLE LIFELINE SYSTEMS

PROBEL
SAFETY SYSTEMS ENGINEERED FOR LIFE

DESCRIPTION

When workers require safe horizontal mobility over an extended distance while operating close to a vertical drop, single point anchors along an entire work zone may not be feasible or desirable due to the danger of swing fall hazards. The solution is a fully engineered horizontal cable lifeline system.

A horizontal cable lifeline system is a permanently installed, multi-span anchored cable which serves as an attachment point for travel restraint or fall arrest lanyards.

Horizontal Cable System Types

Pro-Bel offers two types of horizontal cable lifeline systems:

"Hands-Free" Horizontal Lifeline; a stainless steel 5/16" (8 mm) cable system employing a runner that follows the worker along the cable and *mechanically bypasses* all intermediate brackets without disconnecting thereby providing *continuous* "hands-free" protection regardless of travel surface geometry.

Note: Pro-Bel cable runners that lock in one or both directions to negotiate slopes require some tension on the lanyard to operate, however Pro-Bel runners lock onto the cable if the horizontal cable changes to a vertical mode.

Double Lanyard (DL) Horizontal Lifeline; a galvanized or stainless steel 5/16" (8 mm) cable system employing a double lanyard method of providing 100% tie-off and an inline shock absorber to reduce the applied loads to the end and corner anchors. The DL system is more economical than the "Hands-Free" system, however, there is a human error element of risk if workers are completely detached during the transfer procedure required either side of anchor points i.e. *non-continuous*.

USE

For horizontal mobility over extended distances while working close to a vertical drop e.g. within 6'-0" (1.8 m) of roof edge (ANSI/IWCA I-14.1 and OSHA 1926.502), or any high, narrow roof area or walkway.



Worker above uses Pro-Bel "Hands-Free" Horizontal Lifeline Cable to safely access recessed windows as well as custom ledge-mounted Pro-Bel safety anchors (one for bosun's chair and one for lifeline) for "drops" as indicated at right, which shows four window cleaners working same facade.



As an alternative to single anchor points when individual 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 rigging equipment.

The Pro-Bel "Hands-Free" horizontal lifeline system employs a variety of runners to serve special applications such as vertical, inclined and arched lifeline installations. Pro-Bel offers 3 types of runners that can be hooked and unhooked at any location on the cable:

1. Simple horizontal runner.
2. Fall Arrest runner (can also be used in vertical applications).
3. Reversible fall arrest runner that locks onto cable in any direction.

Exterior or interior.



Worker turning corner of building without disconnecting via 90 degree corner fitting on "Hands-Free" system.



Sloped and domed roofs are often designed with a gutter-type lifeline cable system.

Travel Restraint & Fall Protection Equipment

FEATURES

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

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

Installation flexibility; Pro-Bel Horizontal Cable Lifeline 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 and ANSI/IWCA I-14.1 requires that horizontal lifelines be designed by or under the direction of a registered professional engineer experienced in such design. Pro-Bel system performance is based on data derived from independent testing and/or engineering calculations. Horizontal lifelines are designed and installed as part of a complete personal fall arrest system and maintain a safety factor of at least two.

Compatible with roofing; many horizontal lifeline supports require mounting to the roof deck or superstructure. An important consideration in the design of Pro-Bel supports 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; Pro-Bel installations automatically carry \$5,000,000.00 coverage against product/system failure (over 8000 projects successfully completed to date).



Intermediate anchors consist of support brackets and U-bars if horizontal lifelines (and rigging lines) are used for window cleaning.

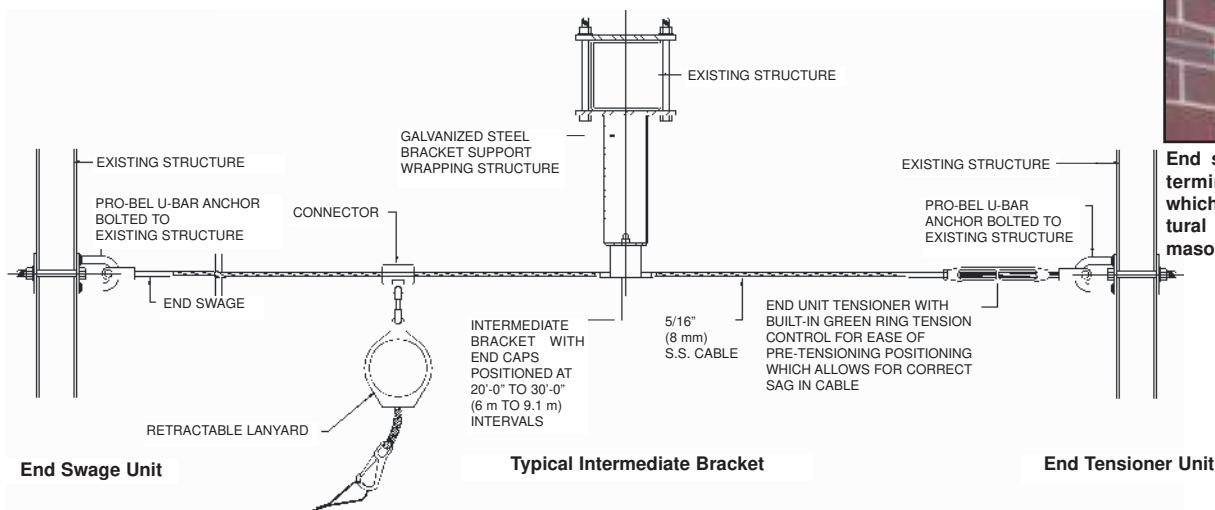


Pro-Bel end anchor supports are reinforced to take the applied loads. Computerized modeling is used to determine the loads applied to the structure. Photo shows roof access point at the beginning of the lifeline system.



Pro-Bel installer above tests bypass connector at intermediate bracket on Pro-Bel "Hands-Free" Horizontal Cable Lifeline System which is used to access Pro-Bel U-bar wall anchors. Bracket is secured to wall anchor which, in turn, is secured to mechanical room wall. Photo at right shows same worker (using a lanyard with rope grab attached to a rope lifeline) working his way down a sloped metal roof. A separate wall anchor is used to rig a bosun's chair for cleaning windows on face of building.

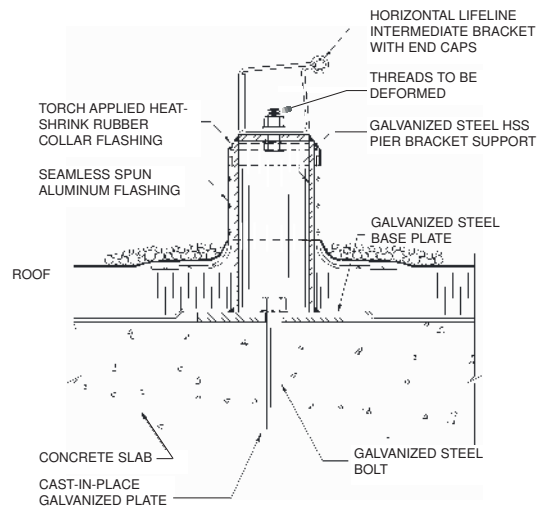
PRO-BEL "HANDS-FREE" LIFELINE



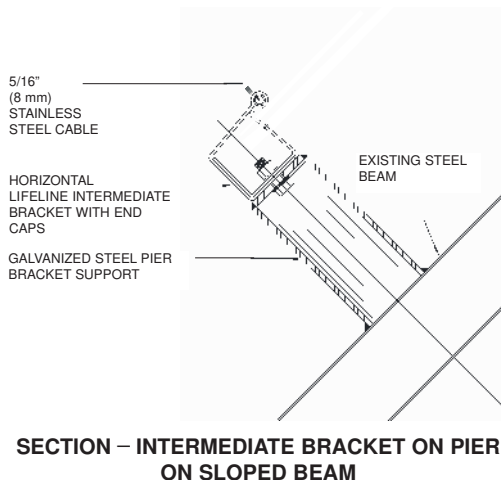
PLAN VIEW – TYPICAL CABLE (Terminal to Terminal)



End swage connected to terminal U-bar anchor which is welded to structural steel penetrating a masonry wall.



SECTION – INTERMEDIATE BRACKET ON PIER ON ROOF



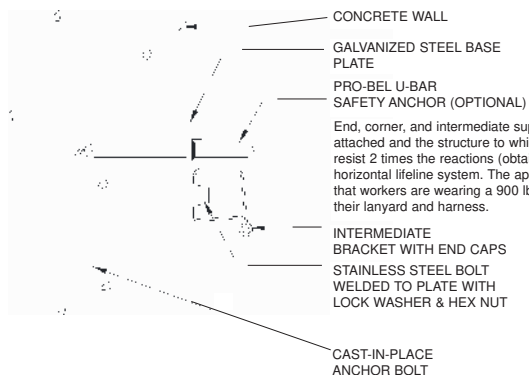
SECTION – INTERMEDIATE BRACKET ON PIER ON SLOPED BEAM



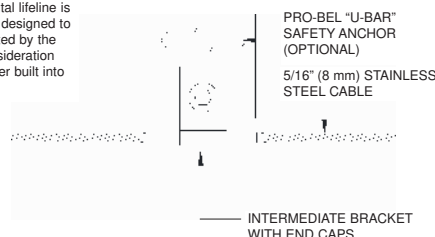
Intermediate support brackets/anchors are designed to suit all types of wall and roof conditions.

Secure Cable Positioning

The 5/16" (8 mm) stainless steel cable feeds through the neck of the intermediate bracket which means it is firmly held in place and cannot oscillate in windy environments.



SECTION – INTERMEDIATE BRACKET ON WALL



FRONT VIEW



"Hands-Free" cable supports are often designed with a U-bar safety anchor for direct rigging of a bosun's chair.

MATERIALS/FABRICATION (as applicable)

"HANDS-FREE" HORIZONTAL LIFELINE

Cable: 5/16" (8 mm) diameter, Type 316 stainless steel with minimum breaking strength of 9,000 lbs (40kN).

Cable system entry points are equipped with a prominently displayed non-corrosive data plate clearly stating maximum service capacity, and number of users.

Standard intermediate support brackets: multi-position, Type 316 stainless steel with reinforcing end caps and suitable for installation at any height. Secured using 1/2" (12 mm) diameter fasteners.

Mobile intermediate support brackets: multi-position, Type 316 stainless steel; provides greater flexibility for working both sides of sloped roof at ridge point.

End terminal hardware: Type 316 stainless steel with polished finish, swaged end termination at one end and tensioner with pre-tension indicator and shock absorber at other end.

Lanyard cable runner: Type 316 stainless steel, with automatic runner bypass feature for continuous "hands-free" operation that can be inserted or removed anywhere on the cable. A mid-point entry/exit unit is also available, or a detachable runner can be inserted/detached anywhere along the cable (to facilitate window cleaning practices. See page HC-2 for runner types and shaded paragraphs on page HC-6).

Harness: manufacturer's standard "hands-free" full body harness complete with shock absorbing lanyard.

Accessories: manufacturer's standard flexible 90 degree corner unit, double anchor point; 90 degree corner unit, single anchor point; 135 degree corner unit.

End and intermediate anchors: Pro-Bel PBE or PB Series wall and roof safety anchors, consisting of the following:

U-bar, anchor bolts: Type 304 stainless steel with yield strength of 35 Ksi (240 MPa) or mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot-dip galvanized to ASTM A123/A 123M-2000.

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

Hollow steel section (HSS) piers: galvanized mild steel as above with yield strength of 50 Ksi (350 MPa).

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

Seamless spun aluminum flashing (for steel pier anchors): Type 6061-T6 alloy to ASTM B221-2006 with deck flange flashed in using felt plies to NRCA or CRCA recommendations or roofing membrane manufacturer's instructions.

Top of anchor sealing (for steel pier anchors): torch applied heat-shrink rubber collar flashing.



Typical intermediate support bracket with automatic connector bypass feature for continuous "hands-free" operation.



Worker making uninterrupted transition from vertical mode to horizontal mode.



Sloped roof access has become a common requirement in recent years and provides a considerable challenge to the window cleaning fall protection industry. Horizontal cable systems, designed to allow ascent and descent on slopes, permits users to remain continuously connected. Inset shows terminal end hardware.

Generally, the intent of a horizontal cable lifeline is to provide safe horizontal movement to a work station and back again. In the case of window cleaning operations on most high rise buildings, the intent is to provide safe passage to the window cleaning equipment while allowing the window cleaner to move about and set up both primary equipment (stage, cage or bosun's chair) and lifelines.

In this instance the window cleaner must be able to disconnect the "lanyard cable connector" anywhere along the cable i.e. at any given work station, and take it down to the ground while cleaning and back up to the roof again for reconnection to the horizontal cable, for safe passage to the next work station or entry/exit position.

MATERIALS/FABRICATION (as applicable)

DOUBLE LANYARD (DL) HORIZONTAL LIFELINE

Cable: 5/16" (8 mm) diameter galvanized or stainless steel.

Tether: portable double lanyard with double snapping hooks.

End terminal hardware: galvanized or stainless steel swaged termination at one end and galvanized or stainless steel tensioner with shock absorber at other end.

Harness: manufacturer's standard full body harness with shock absorber.

End and intermediate anchors: Pro-Bel PBE or PB Series wall and roof safety anchors, consisting of the following:

U-bar, anchor bolts: Type 304 stainless steel with yield strength of 35 Ksi (240 MPa) or mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot-dip galvanized to ASTM A123/A 123M-2000.

Hollow steel section (HSS) piers: galvanized mild steel as above with yield strength of 50 Ksi (350 MPa).

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

Seamless spun aluminum flashing (for steel pier anchors): 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 anchor sealing (for steel pier anchors): torch applied heat-shrink rubber collar flashing.

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



Corner anchors are used with a double lanyard system when changing direction. Anchors are typically placed at the same distance from the roof edge.



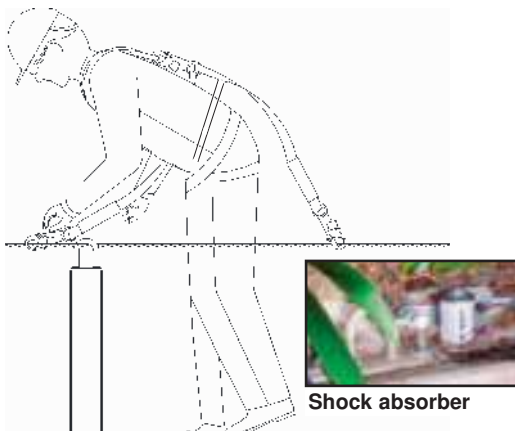
Workers traversing spandrel ledge under sloped roof canopy using DL Horizontal Cable Lifeline system (post mounted).



Photo shows Pro-Bel DL Horizontal Cable Lifeline system which employs double lanyard method of providing 100% tie-off. Parapet in this narrow roof area is less than 42" (1067 mm) safety guardrail height.



Photo shows terminal end of permanently installed DL Horizontal Cable Lifeline System. Swaged connection (shown) is at one end and a turnbuckle tensioner at opposite end.



Pro-Bel Double Lanyard (DL) Horizontal Lifeline system showing transfer from one side of intermediate anchor to the other.

DESIGN CONSIDERATIONS

Amplified loads: Horizontal lifelines are a highly restricted* fall protection system requiring extremely careful engineering.

These systems when used in high rise applications are normally intended for restraint, but should be engineered for fall protection in the event the system becomes overloaded or misused. Horizontal cable systems are not recommended for direct rigging or the tie-back of primary equipment due to the potential for excessive loading i.e. equipment failure. For example, it is possible for working loads to be exceeded using any one or a combination of the following scenarios:

- cable geometry or angle of sag;
- when a fall arrest situation occurs and more users are attached to the cable system than are allowed.
- failure of primary suspension equipment i.e. chair or platform inadvertently rigged or tied back to the cable.

A worker in a body harness free falling 6'-0" (1.8 m) can exert an arresting force of up to 1,800 lbs. (8 kN) the maximum distance and force permitted by OSHA. However, horizontal lifelines, depending on their geometry and angle of sag, may be subjected to greater loads than the impact load imposed by an attached component.

For example, when the angle of sag is 5 degrees, the impact force imparted to the horizontal cable is 6 times the applied force. This sag can also increase free fall distance substantially beyond the 6'-0" (1.8 m) maximum OSHA requirement. On the other hand, too taut a cable combined with the load of a worker falling can result in greatly amplified loads which means that the end anchors and their structure can be subjected to 6 to 10 times the normal loading. A little natural sag in the cable having only a negligible effect on free fall distance is considered ideal.

Other architectural considerations with horizontal cables having too much sag include:

- cables in contact with the roof surface or close to walls combined with wind forces can abrade or damage roof and/or wall surfaces;
- unwanted sound (noise) produced due to the effect of wind harmonics.

The design of lifeline systems must only be done by qualified persons. Testing of installed lifelines and anchors prior to use is recommended.

Attaching lifelines: Connecting worker vertical safety lifelines onto a horizontal cable system can be accomplished with restrictions. Consult Pro-Bel for details.

Free Design Service: The selection of window cleaning 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.

RELATED DATA

For general data relating to all Pro-Bel products and services e.g. codes, installation, warranty, etc., refer to Pro-Bel 32 page general literature.

For product data relating to other fall protection systems and primary suspension equipment, see other Pro-Bel literature.



Pro-Bel "Hands-Free" Horizontal Cable Lifeline System (secured to ridge structure) is used to safely access Pro-Bel U-bar safety anchors for window cleaning. The cable system may also be used to access/service rooftop mechanical units.

* The intent of OSHA is to provide safety guardrails at elevated passageways (non-restrictive system). When considering restricted horizontal lifeline systems, specific work procedures must be employed and workers must demonstrate proper procedure to ensure safety.

HORIZONTAL CABLE LAYOUT PROCEDURE

1. Review the Pro-Bel **System & Equipment Introduction literature** (pages G-6 to G-18). This data provides an overview of the various equipment options used to clean windows or perform other suspended building maintenance.

2. On the architectural roof plan, mark window locations or other areas requiring horizontal cable access.

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 intermediate brackets, steel piers and U-bar anchors are anchored to structural concrete wall or slabs, steel superstructure, or similar elements.

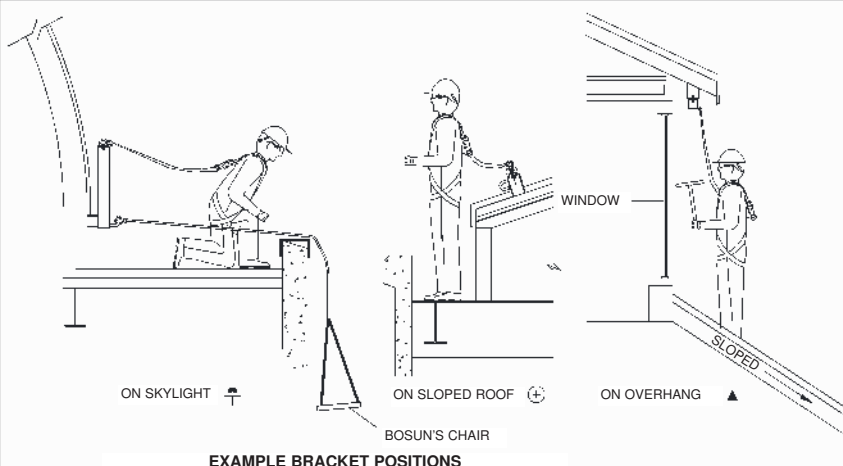
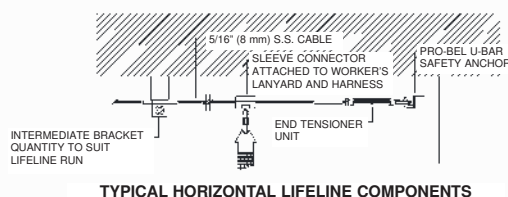
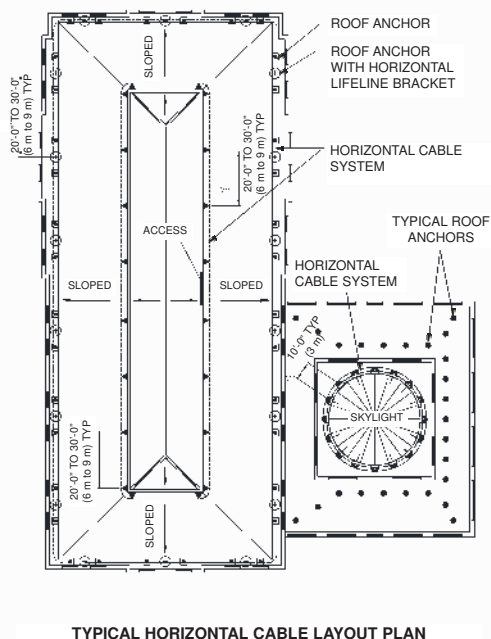
6. Review the Design Considerations on page HC-7 to assist in making a "rigging" decision.

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 anchor points generally following the spacing recommendations noted on drawing page HC-4 for either horizontal cable system i.e. 20'-0" to 30'-0" (6 m to 9.1 m) centers.

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

10. If, in addition to horizontal movement, vertical access is required to clean windows, for caulking, metal polishing or other building maintenance, determine if maintenance can be performed using a bosun's chair, single work cage or suspended platform. Add lifeline and tie-back anchors at appropriate centers. A "drop" for a chair is typically a 6'-0" (1830 mm) wide area, 8'-0" (2440 mm) wide for a single work cage, and 24'-0" (7315 mm) wide for a platform. Lay out anchors to suit tie-back and lifeline requirements. Refer to Pro-Bel Safety & Tie-Back Anchors literature.



"Hands-Free" Bypassing Motion

The intermediate bracket can be installed in a number of positions. As illustrated above the bracket position is dependent upon both the height of the installed cable in relation to the user's walkway and the orientation of the mounting surface. The versatility of the Intermediate bracket allows the connector to function at all cable heights.

SPECIFICATION

SPEC NOTE: This basic guide specification (Section 11 24 23 - Window Washing Systems) is devoted exclusively to horizontal lifeline cables 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 rail 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. Section [01 31 19 - Project Meetings]
- B. Section [01 61 00 - Common Product Requirements]
- C. Section [01 74 00 - Cleaning and Waste Management]
- D. Section [03 30 00 - Cast-in-Place Concrete: concrete runway, piers and sleepers for roof cars].
- E. Section [05 05 23 - Metal Fastenings: horizontal lifeline fasteners].
- F. Section [05 50 00 - Metal Fabrications: monorail and davit system cantilevered support brackets].
- G. Section [07 62 00 - Sheet Metal Flashing and Trim: aluminum flashing for davit bases].
- H. Section [08 31 13 - Access Doors and Frames: rigging access doors in walls].
- I. Section [08 44 00 - Curtain Wall and Glazed Assemblies: mullion and stabilization co-ordination].
- J. Section [22 11 16 - Domestic water Piping: hot and cold water supply, faucets and drains at [every] roof level].
- K. Section [26 00 00 - Electrical: climbing monorail power supply].
- L. Section [26 20 00 - Low Voltage Electrical Transmission: three phase 208 volts 60 Hertz service at [every] roof level].
- M. Section [26 25 00 - Enclosed Bus Assemblies: climbing monorail busbar].
- N. Section [01 78 00 - Closeout Submittals].

1.04 References

- A. AISC 360-05 "Load and Resistance Factor Design Specification for Structural Steel Buildings".
- B. AISI SG-02KIT with 2001 Supplement "Specification for Design of Cold-Formed Steel Structural Members".

- C. Aluminum Association AAADM-1-Aluminum Design Manual, 2000 and ANSI/AWS D1.2/D1.2M:2003 Structural Welding Code - Aluminum.

- D. ANSI/AWS D1.1/D1.1M:2008 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 cable to suit 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 to comply with the following fall arrest system (FAS) requirements:
 - 1. Limit maximum arresting force on a user/employee to 1800 lbs (8 kN) maximum arrest force (MAF) when used with a body harness.
 - 2. Rigged such that a user/employee can neither free fall more than 6'-0" (1.8 m) nor contact any lower level.
 - 3. "Hands-Free" system: End supports, corner supports, and intermediate supports to which a horizontal lifeline is attached and the structure to which they are attached are designed to resist 2 times the reactions (obtained by analysis) generated by the horizontal lifeline system. The applied loads take into consideration that workers are wearing a 900 lbs (4.0 kN) shock absorber built into their lanyard and harness.
 - 4. Double Lanyard system: End supports and corner supports of the DL horizontal cable lifeline and the structure to which they are attached are designed to resist 2 times the reactions (obtained by analysis) generated by the horizontal lifeline system incorporating an inline shock absorber to help control the applied loads. The DL system is normally designed for a maximum of two workers wearing a lanyard and harness incorporating a 900 lbs (4.0 kN) shock absorber.

1.06 Shop Drawings and Engineering Certification

- A. Submit shop drawings showing complete layout and configuration of complete horizontal cable 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 \$2,000,000.00 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 Subpart F (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.

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 based on systems currently being manufactured by PRO-BEL GROUP LTD., Toll free: 1-800-461-0575. Telephone: 905-427-0616, Fax: 905-427-2545, info@probel.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 cleaning 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. Hollow steel section (HSS) pier supports: galvanized mild steel as above with yield strength of 50 Ksi (350 MPa). Wall thickness to suit application.
- B. 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.
- C. Securement bolts: mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot dipped galvanized to ASTM A123/A 123M-2000.
- D. 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/A 123M-2000]. U-bar to be not less than 3/4" (19 mm) diameter material with 1-1/2" (38 mm) eye opening.

SPEC NOTE: Re 2.03,E. 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. Specify conformable mastic tape and heat-shrink rubber collar flashing for PBE Series roof anchors (BUR or modified bitumen roofs) or s.s. cap for PB series roof anchors (any type roof).

- E. Seamless spun aluminum flashing (for steel pier supports): 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.

- F. Miscellaneous bolts, nuts and washers: mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot-dip galvanized to ASTM A123/A 123M-2000 or Type 304 stainless steel with yield strength of 35 Ksi (240 MPa).

Hands-Free" Horizontal Lifeline System

SPEC NOTE: The following material clauses are for the "Hands-Free" Horizontal Lifeline System".

- G. Cable: 5/16" (8 mm) dia., Type 316 stainless steel with minimum breaking strength of 19,125 lbs. (85 kN), complete with permanently swaged cable ends.
- H. Data plate: cable system entry points to be equipped with prominently displayed non-corrosive data plate clearly stating Maximum Service Capacity and Number of Users.
- I. Standard intermediate support brackets: multi-position Type 316 stainless steel with reinforcing end caps and suitable for installation at any height. Secured using 1/2" (13 mm) dia. fasteners.
- J. Mobile Intermediate support brackets: multi-position, Type 316 stainless steel for working both sides of sloped roof at ridge point.
- K. Corner units: manufacturer's standard 90° or 135° flexible corner units as required.
- L. End terminal hardware: stainless steel swaged termination at one end and stainless steel tensioner with shock absorber at other end as required.
- M. Lanyard cable runner: Type 316 stainless steel with automatic runner bypass for continuous "hands-free" operation that can be inserted or removed anywhere on the cable.
- N. Harness: manufacturer's standard "hands-free" full body harness and lanyard complete with shock absorber.

Double Lanyard (DL) Horizontal Lifeline

SPEC NOTE: The following material clauses are for the Double Lanyard (DL) Horizontal Lifeline.

- G. Cable: 5/16" (8 mm) dia. galvanized steel with minimum breaking strength of 19,125 lbs. (85 kN), complete with matching permanently swaged or mechanically swaged cable ends, and shock absorber.
- H. Data plate: cable system entry points to be equipped with prominently displayed non-corrosive data plate clearly stating Maximum Service Capacity and Number of Users.
- I. Tensioner: steel turnbuckle, same material as cable.
- J. Harness: manufacturer's standard full body harness with double lanyard and shock absorbers.

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.

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

- B. Co-ordinate installation with work of related trades.
- C. Install all work true, level, tightly fitted and flush with adjacent surfaces as required.
- D. Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.
- SPEC NOTE: Re 3.02,E. Specify for furnish only projects if required.*

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

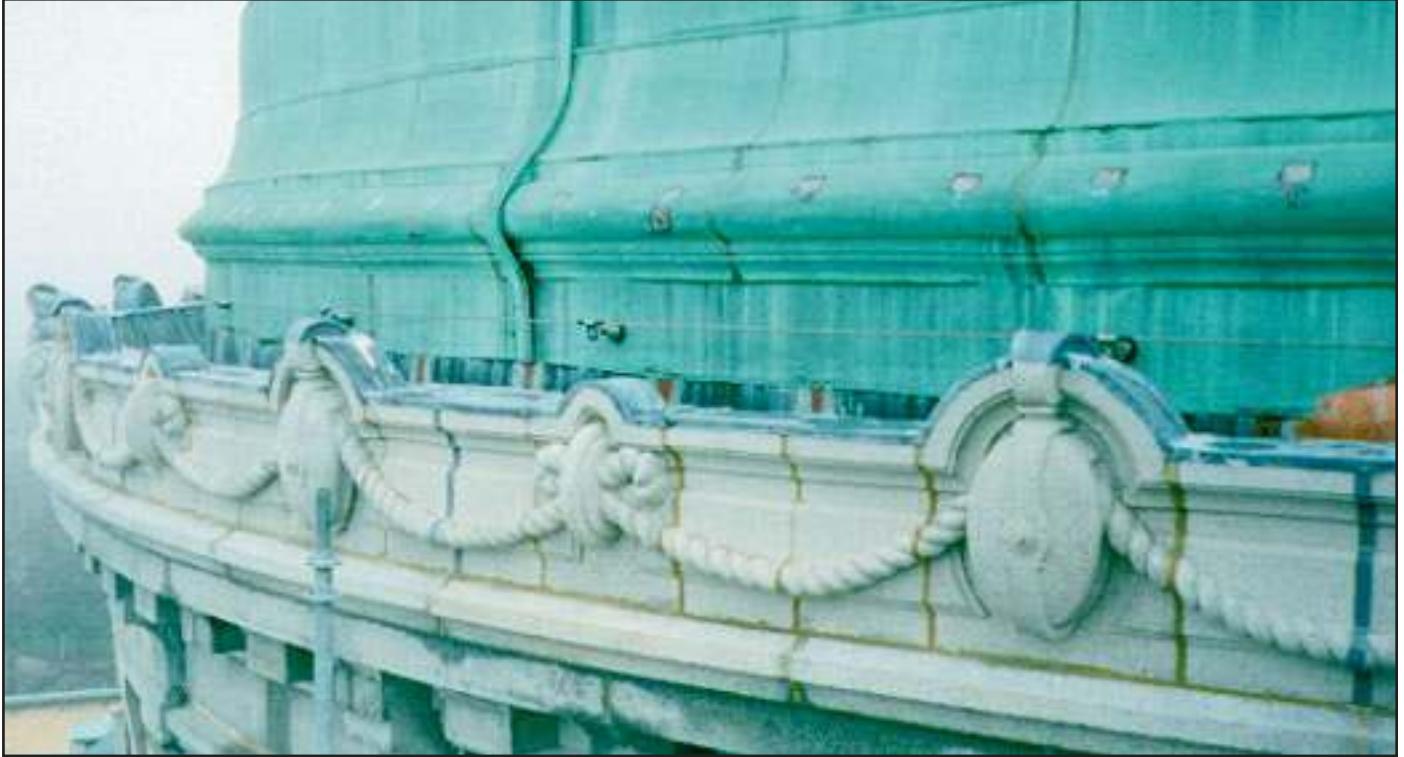
3.03 Final Adjusting and Inspection

- 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.

LET PRO-BEL DESIGN YOUR FALL ARREST SYSTEM



Pro-Bel Horizontal Cable Lifeline System is used to provide safe access in the narrow roof area around the base of this copper dome. Parapet is less than 42" (1067 mm) guardrail height. United States Naval Academy (USNA) Chapel, Annapolis, Maryland.



Pro-Bel "Hands-Free" Cable Lifeline system is used for window cleaning, roof inspection and similar maintenance. Vertical cable system is used with both access ladders at right to reach both roof levels safely.



Lifeline application on narrow roof area with low parapet.



Worker changing to second lanyard while traversing DL Horizontal Lifeline up sloped atrium. Intelsat Global Service Corporation, Washington, D.C.

Generally, the intent of a horizontal cable lifeline is to provide safe horizontal movement to a work station and back again. In the case of window cleaning operations on most high rise buildings, the intent is to provide safe passage to the window cleaning equipment while allowing the window cleaner to move about and set up both primary equipment (stage, cage or bosun's chair) and lifelines.

In this instance the window cleaner must be able to disconnect the "lanyard cable runner" anywhere along the cable i.e. at any given work station, and take it down to the ground while cleaning and back up to the roof again for reconnection to the horizontal cable, for safe passage to the next work station or entry/exit position.

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