



POWERED ROOF CARS

MAINTENANCE EQUIPMENT
window washing systems

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Pro-Bel Enterprises
Limited

**Window Cleaning/Suspended Maintenance
Equipment & Fall Protection Systems**

1-800-461-0575

www.pro-bel.ca info@pro-bel.ca

SUSPENDED EQUIPMENT & FALL PROTECTION

EXPERTS

DESCRIPTION

Dedicated to a specific building and owner purchased, Pro-Bel roof car systems and similar equipment e.g. rubber tire and long span boom machines, represent a generation of suspended maintenance equipment above that of other primary rigging equipment.

A roof car, normally mounted at the highest elevation of the building, travels along I-Beam tracks, pipe rails, or concrete corridors/runways.

Roof cars are engineered to accommodate long span booms making it possible to extend the platform beyond terraces or roofs at lower levels. This feature can reduce or eliminate the need for additional roof cars, davits, or other primary equipment at lower levels.

Another consideration in "super-skyscraper" applications is the length of the control cable required to operate the hoisting mechanism. To eliminate the need for a control cable between the platform and the roof car, Pro-Bel employs a remote controlled hoisting system or control cable interwoven with any one of the four platform suspension cables to raise and lower the platform.

Cars can be described as follows:

Fixed - a simple roof car equipped with a stationary boom of a fixed length.

Telescoping - when boom length is required to telescope out during rigging and maneuvering of roof car.

Fixed and telescoping boom machines are also designed with luffing and slewing capabilities.

Luffing - a luffing (up and down) boom allows for variable reach and flexibility of roof rigging over multiple parapet conditions.

Slewing - allows the roof car boom to swivel or rotate, which provides ease of platform manipulation and a greater degree of flexibility in roof rigging and storage options.

Note: the stabilization of the platform, an OSHA requirement for buildings over 130'-0" (39.6 m) is necessary to keep the equipment in contact with the building facade to prevent unwanted movement due to wind action. See Pro-Bel Stabilization Systems literature.

USE

Permanent powered platforms rigged with conventional permanent support equipment such as davits, outrigger beams, monorails, etc. are impractical on modern skyscrapers. Many of these buildings require roof cars in order to accommodate multi-level rigging, long span reaches, high parapets and other complicated building geometries.

A motorized roof car system also provides complete horizontal movement via a roof mounted track system or a rubber tire machine. These systems significantly reduce the setup time between stage drops.

Generally there are two types of roof car designs:

1. With traction hoists and wire winders on the platform

This design is suited to buildings under 450'-0" (137 m) in height, however the platform is typically small e.g. maximum 10'-0" (3 m), to accommodate the added weight of the suspension lines and power cord. The benefits of this type of roof car include being able to transfer the platform to other roofs for use with conventional supports, e.g. davits, outriggers, monorails, etc., and platform occupants can lower the platform to the ground using a descent

control feature in the event of a power failure. See Pro-Bel Permanent Powered Platforms literature.

2. With hoisting system on the roof car

This design is suited to buildings over 450'-0" (137 m) in height requiring a platform longer than 10'-0" (3 m). The benefits of this type of roof car include eliminating the added weight of the suspension cables which are now coiled at roof level using drum type hoists. Also, to eliminate the added weight of the power cord on the platform, a control cable can be interwoven in any one of the suspension cables or a radio-type remote control can be used to raise and lower the platform. A limitation of this type roof car is that with the main controls at roof level, in the event of a power failure, a communication and training system is necessary to permit a worker on the roof to activate the descent control apparatus allowing the platform to safely descend to the ground.



A variation of Pro-Bel Model FS-3000 Trolley Roof Car. Trolleys are supported on 4 wheel assemblies operating on galvanized pipe rails mounted on concrete piers cast into the roof slab. Steel base and suspension jibs have 360° slewing and luffing capability.

Primary Suspension Equipment



Pro-Bel Model RA T22 roof anchored trolley roof car with long single telescopic jib traveling on galvanized I-Beam track mounted on concrete piers. Slewing capability allows access to wide portion of building facade.

2FEATURES

Wide choice of designs; Pro-Bel roof cars can be manufactured to suit virtually any access requirement or building geometry.

Ease of maintenance and repair; Pro-Bel's advanced Sensorium™ controller and electronic diagnostic system virtually eliminates troublesome major problems typically associated with controls that use switches, limit switches, and interlocks.

All corrosion resistant materials; components are aluminum, hot dipped galvanized steel, specially treated powder coated steel, and stainless steel.

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

Engineer certified; Pro-Bel roof car and platform performance is based on data derived from independent testing and/or engineering calculations.

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

Specific liability insurance; all Pro-Bel installations automatically carry \$2,000,000.00 coverage against product/system failure (over 4000 projects successfully completed to date).



This roof car employs a counterweight to help move the platform inboard of suspension points to reach glass under sunscreens.



Pro-Bel Model PT 3008 powered trackless trolley supported on hard rubber tired wheels travels freestanding fully balanced on concrete bearing surface (or similar) cast on top of the roof finish (360° slewing and luffing capability).

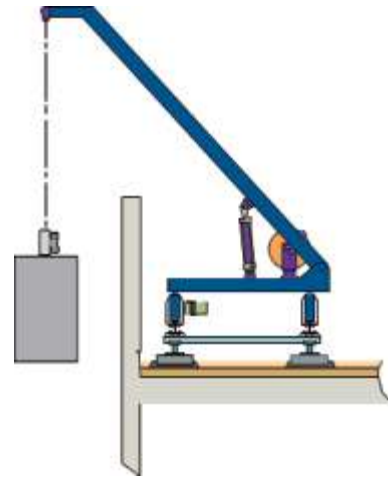


Pro-Bel Model RA-3006 roof anchored trolley with jib end pantograph assembly. Designed to clear very high parapets.



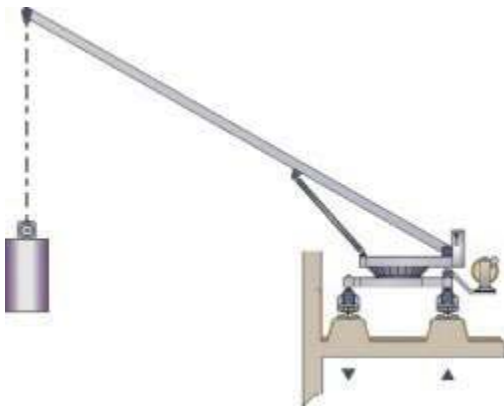
Trolley is supported on hard rubber tired wheels and operates on a reinforced concrete bearing surface (or similar) cast on top of the roof finish. A roof trolley is guided by an L-shaped steel angle fixed to the concrete runway. Steel base frame and suspension jib have 360° slewing (rotating) and luffing (up and down) capability.

MODEL PT 3008
Fully Balanced Powered Trackless Trolley



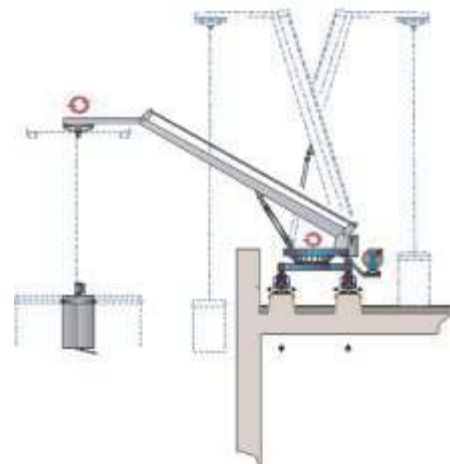
Fully balanced roof car on freestanding track system operates on twin galvanized I-beam track system supported on galvanized steel crossbeams over support foot assemblies bearing on reinforced concrete pads or sleepers bedded on top of the roof finish. Weight balance ratio to be as per authorities having jurisdiction. Steel base frame and suspension jib has luffing (up and down) capability.

MODEL FS 3000
Free Standing Trolley



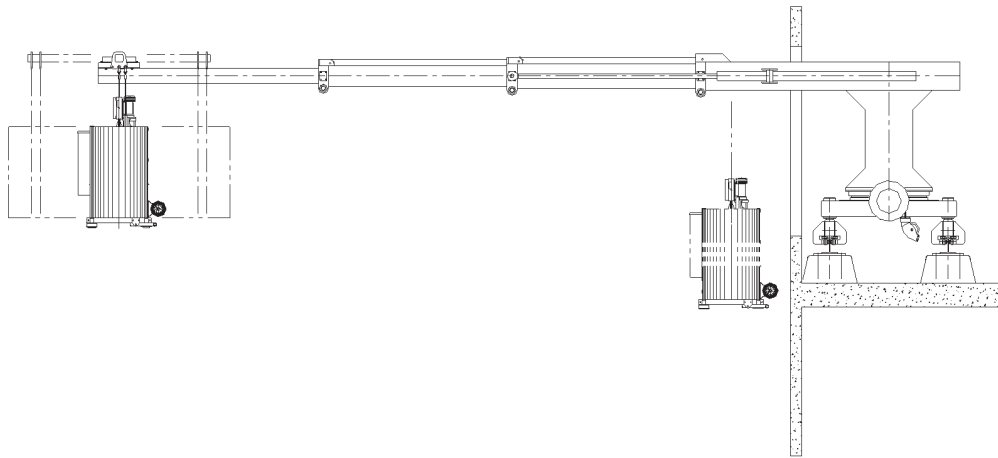
Trolleys are supported on four wheel assemblies operating on galvanized track mounted on concrete piers or crossrails cast into the roof slab. Steel base frame and suspension jib have 360° slewing (rotating) and luffing (up and down) capability.

MODEL RA 3004
Roof Anchored Trolley



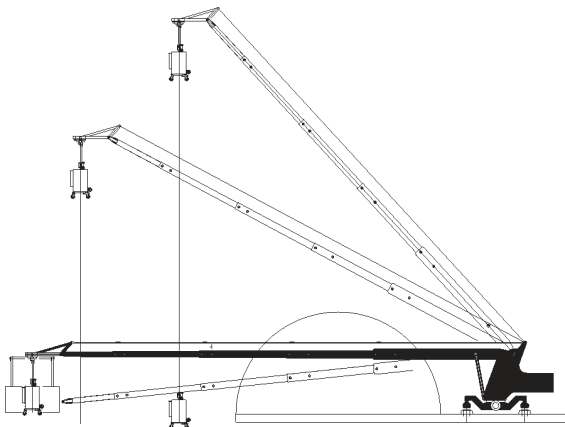
Designed to clear very high parapets, the trolleys are supported on four wheel assemblies operating on galvanized track mounted on concrete piers or crossrails cast into the roof slab. Steel base frame and suspension jib have 360° slewing (rotating) and luffing (up and down) capability. The pantograph assembly always remains horizontal whatever the inclination of the jib. The connecting upper turret assembly allows the platform to be rotated 90° to provide added platform access. Also available with optional telescoping jib.

MODEL RA 3006
Roof Anchor Trolley w/Jib End Pantograph Assembly



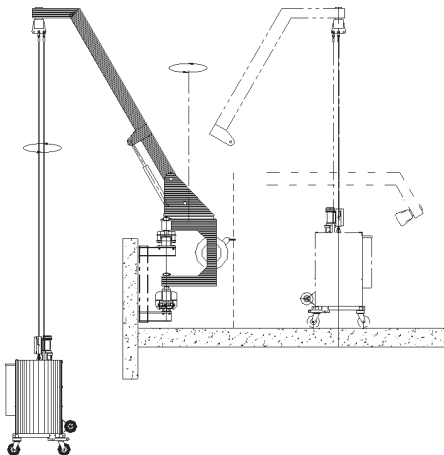
MODEL RA T09
Roof Anchored Trolley w/ Short Single Telescopic Jib

Trolleys are supported on four wheel assemblies operating on galvanized tracks mounted on concrete piers or crossrails cast into the roof slab. Steel base frame and telescopic suspension jib have 85° slewing (rotating) capability in each direction. The connecting upper turret assembly on the jib end allows the platform to be rotated 90° to provide added platform access.



MODEL RA/22.5
Roof Trolley, Special Type/Long Reach

Trolleys are supported on four wheel assemblies operating on galvanized track mounted on concrete piers cast into the roof slab. Steel base frame and long reach suspension jib have 360° slewing (rotating) capability and luffing (up and down) capability. The pantograph assembly always remains horizontal whatever the inclination of the jib. The connecting upper turret and suspension beam assembly allows the platform to be rotated 180° to provide added platform access.



MODEL PRT 2200
Parapet Mounted w/ Twin Track Trolley and Single Jib

Trolleys are supported on four wheel assemblies operating on a galvanized lower I-beam and upper galvanized steel channel track, all mounted onto a structural parapet wall. Steel base frame and suspension jib have 360° slewing (rotating) and luffing (up and down) capability. A slewing bearing at the end of the jib arm can be incorporated.

MATERIALS/FABRICATION
(as applicable)

Wheel assemblies: depending on car selected wheel assemblies may be: hard rubber tired, mounted in bearing assembly; pivoting caster wheels (rubber tired); tired in stainless steel; fitted with motorized traversing unit via a direct drive onto the axle.

Base frame assembly: robust design fabricated using heavy duty steel box section. Bearing housings are incorporated in the frame for the wheel units together with attachment points for the slewing assembly, bearing, or wheel units.

Upper turret assembly: robust design fabricated using steel plates with attachment points for hydraulic cylinder, jib assembly and slewing motor, and hydraulic tank with compartments for the hydraulic valves and electrical controls.

Jib assembly: robust design fabricated using heavy duty steel box section. Suspension boom is supplied with attachment points for four wire suspension.

Luffing assembly: consists of heavy duty, double acting hydraulic cylinder with electrically operated power pack including tank, filter, pressure relief valve, motorized pump and solenoid operated directional control valves. System working pressure is between 1200 to 1500 psi (8274 to 10 342 kPa). Anti-pipe burst valve is fitted to base of cylinder which lowers jib at controlled rate in case of pipe failure.

Supply cable reeling drum: spring loaded, 66'-0" (20 m) capacity to automatically reel in/out electrical power supply cable between the roof power sockets and the roof trolley.

Donkey traverse assembly: hard rubber tired wheel mounted in a bracket complete with bearings with power provided by hydraulic motor directly driving the wheel. Pivoting uplift wheel units keep wheels clamped to track for necessary traction required.

Main slewing assembly: precision man-

ufactured slewing bearing attached to upper turret and lower base frame. Provides 360° powered rotation via hydraulic geared motor transmission controlled by push buttons from either control station.

Telescoping jib assembly: 4 telescoping square steel sections fitted with guide roller assemblies operating on taper roller bearings to reduce extension/contraction loads. Extension and contraction to be carried out by means of double acting hydraulic cylinder together with a system of linking chains. The 4 wheel assemblies incorporate one upper wheel fitted with taper roller bearings together with four uplift wheel assemblies. In addition each wheel assembly is fitted with 4 horizontal wheels, tired in stainless steel which operate on the vertical web of the rails.

Suspension beam assembly: steel fabrication incorporating a slewing bearing to facilitate rotation of the platform relative to the building face. Slewing action is power operated via a motorized worm gearbox and gearing. The beam is limited to approx. 85° rotation in each direction.

Pantograph assembly: steel fabrication pivoted to top of jib and attached to upper turret via pantograph tie rods.

Platform mounted hoists: 2 x 1102 lbs (500 kg) capacity, each on primary suspension wire ropes; safety brakes 2 x on secondary safety wire ropes.



This roof car, located on the roof of a 47 storey tower with a very complex building geometry is equipped with an 84'-0" (25.6 m) long slewing boom and travels in two directions on I-Beam rails. A pivoting trolley that moves along the full length of the boom is used to suspend the platform. 1000 De La Gauchetiure, Montreal, Quebec.

Electrical: on/off control of the power supply is by means of a key operated switch mounted on the roof car. A further key operated selector switch is provided on the roof car so the operatives can select control to the platform station or the roof car station. The roof car is fitted with a pendant control station incorporating all push buttons required to control all movements of the roof car. All buttons require continuous finger pressure and emergency stop buttons are provided at each control position. It is not possible to control raising and lowering of the platform from this pendant control. This must be done by the operatives in the platform. The main electrical control panel is housed in a weatherproof compartment on the car. The panel incorporates all the necessary contactors and switch gear for the circuitry together with a PLC for programming the control circuitry and safety devices.

Power is supplied to the platform via a multi-core power supply cable which is suspended from the suspension beam. This cable is normally stored inside a storage compartment fitted on the rear of the platform. The platform is fitted with a central control station whereby all movements of the roof car can be controlled from the platform. Raising and lowering the platform can only be carried out from the platform control station.

Finishes: roof trolley (roof car) steel fabrication is shot blasted, zinc sprayed, two coats red oxide primer and one coat hammer grey or blue finish. Platform is mill finish aluminum with stirrups standard blue powder coated finish

AVAILABILITY AND COST

Pro-Bel window cleaning/suspended maintenance safety systems are distributed throughout the United States, Canada and Internationally. Budget pricing is provided on a project-to-project basis for both materials and installation, or materials only.

TECHNICAL CONSULTATION

Pro-Bel Enterprises Limited provides a complete technical consultation service, available to architects, consultants, engineers, contractors, and building owners. Without obligation, Pro-Bel will provide interested parties with a proposed window cleaning/suspended maintenance design concept to OSHA requirements, including anchor and equipment locations, securement, roofing details, and specifications.

SPECIFICATION

SPEC NOTE: This basic guide specification (Section 11010 - Window Washing Systems) is devoted exclusively to powered roof cars and is written in accordance with the CSI/CSC Three Part Section Format. It must be adapted to suit the requirements of individual projects. 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. Hot & Cold water supply, faucets and drain at [every] roof level Section [15400]
- M. Three phase 230 volt 60 Hertz service at every roof level Section [16050]

SPEC NOTE: Re 1.03.O. For electric powered roof cars, specify independent protected main line power and weatherproof Hubbell twist-lock receptacle (HBL2720SW, NEMA NO. L15-30R), each to provide 230 volts, 3 phase, 60 HZ, 30 amperes under full loading current of the equipment with not more than 3% voltage drop at the platform. A separate stand alone transformer for the window cleaning equipment may be required. Power to be located no more than 100'-0" (30 m) from window cleaning/suspended maintenance location. Pro-Bel wall or roof anchors may be employed for strain relief. Contact Pro-Bel for requirements.

- O. 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 anchorages to suit suspension equipment which will be used on the building with respect to items such as reach, 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 to comply with the following structural requirements:
 1. Supports for Suspended Platforms: roof cars are used for suspending a powered platform from storage and rigging/working locations on the building. These supports and the structures to which they are attached are typically designed to 1000 lbs (4.45 kN) vertical service load 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 load against fracture or detachment (i.e. 4 to 1 stability factor).
 2. Fall Arrest Safety Anchors: designed to a maximum fall arresting force of typically 1800 lbs (8.0 kN) when wearing a body harness with a safety factor of 2 without any permanent deformation and to 5000 lbs (22.24 kN) against fracture or detachment.

1.06 Shop Drawings and Engineering Certification

- A. Submit shop drawings showing complete layout and configuration of roof car window cleaning/maintenance system, including all components and accessories. Clearly indicate design and fabrication details, glazed areas, 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 prop-



Powered Roof Cars Specification (continued)

erly 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 State or California.

A. Comply with the following OSHA regulations: 1. 1910, Subpart F (Powered Platforms), 2. Appendix C to 1910 (Personal Fall Arrest Systems).

B. Comply with the following New York State regulations: 1. Department of Labour 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 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.

2.02 Equipment

Spec Note: List type and quantity as required.

A. [_____]

B. [_____]

C. [_____]

2.03 Materials

SPEC NOTE: Delete items not required.

A. Powered roof car: fully electric, trolley type with four rope suspension system and designed for horizontal travel as per [Model PT 3008, Fully Balanced Powered Trackless Trolley] [Model FS 3000, Free Standing Trolley] [Model RA 3004, Roof Anchored Trolley] [Model RA 3006, Roof Anchored Trolley with Jib End Pantograph Assembly] [Model RA T09, Roof Anchored Trolley with Short Single Telescopic Jib] [Model RA/22.5 Roof Trolley, Special Type/Long Reach] [Model PRT 2200 Parapet Mounted with Twin Track Trolley and Single Jib]

B. Traversing speed: the maximum rated speed at which the powered roof car may be moved in a horizontal direction is to be 39'-4"/minute (12 m/minute) depending on model selected.

C. Travel limits: provide mechanical stops to protect against having the roof car leave the roof or enter areas not designed for travel. Stop to be capable of withstanding a force equal to 100% of the inertial effect of the roof car in motion with traversing power applied. Equip wheels with obstruction limits to stop traversing of trolleys upon encountering an obstruction.

D. Controls: locate operating devices on the roof car, the working platform, or both. Controls to be of continuous pressure weatherproof electric type. If more than one operating device is provided, arrange devices so that traversing is possible for only one operating device at a time. Connect controls so that roof car does not operate until: 1. The platform is located at its uppermost position of travel and is not in contact with the building face or the fixed vertical stabilizer guides located on the face if the building. 2. All protective devices and interlocks are in a position for traversing.

E. Stability: provide continuously stable roof car, considering overturning moment as determined by 125% rated load, plus maximum dead load and the prescribed wind loading.

F. Roof car access: provide safe access to the roof car and from the roof car to the working platform.

G. Storage: when required, make provisions to secure the roof car in the stored position using tie-down anchors. Cars subject to wind forces to be stored in accordance with the requirements of ASME A120.1-2001.

H. Track works: mild steel, Type 350W with yield strength of 350 MPa (50 Ksi), hot-dip galvanized to ASTM A123/A 123M-2000. Tracks to be straight, true and level, with a step deviation of less than 1/8" (3 mm).

Spec Note: Refer to Pro-Bel Stabilization Systems literature for platform stabilization options.

I. Stabilization:

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 3.2.5. Specify for furnish only projects if required.

D. Manufacturer to assist and/or supervise installation of window cleaning/suspended maintenance equipment installed by others.

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.

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PRO-BEL ENTERPRISES LIMITED

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www.pro-bel.ca

Head Office

765 Westney Road S, Ajax, ON CA L1S 6W1 [t] 905.427.0616 [ft] 800.461.0575 [f] 905.427.2545 [e] info@pro-bel.ca

Western Office

#103-350, East Kent Ave S Vancouver, BC V5X 4N6 [t] 604.687.1301 [f] 604.687.1306 [e] infovan@pro-bel.ca