
PART 1 GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section describes the requirements for the ropeway equipment.

1.3. RELATED SECTIONS:

1. 34 14 13 Aerial Tramway General Requirements
2. 34 14 15 Aerial Tramway Electrical

1.4 REFERENCE STANDARDS

- A. The primary reference standards for the Project are listed below. The ropeway system shall conform to all applicable requirements of these documents including codes and standards referenced therein.
- B. When the drawings and specifications call for materials of construction of better quality or larger size than required by codes, laws, rules and regulations, the drawings and specifications shall take precedence. If the drawings and specifications differ, the specifications shall take precedence.
 1. ANSI B77.1-2011.
 2. California Building Code Title 24 Part 2
 3. Federal OSHA Parts 1910 and 1926.
 4. CAL/OSHA Title 8, Chapter 4, Subchapter 6.1
 5. National Electrical Code, NFPA 70-2011
 6. Minimum Design Loads for Buildings, ASCE 7-10

1.5 QUALITY ASSURANCE

- A. The work of this section shall be performed by a company which specializes in the type of Aerial Tramway Electrical work required for this Project, with a minimum of 5 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
- B. Manufacturer shall specialize in manufacturing the type of Aerial Tramway Electrical specified in this section, with a minimum of 5 years of documented successful experience, and have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions and Division 1 Section "Product Requirements".

1.7 WARRANTY

- A. Comply with General Conditions and Division 2 Section "Product Requirements".

PART 2 PRODUCTS**2.1 UNAUTHORIZED MATERIALS**

- A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the OWNER.

2.2 ACCEPTABLE MANUFACTURERS

- A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

2.3 SUBSTITUTIONS

- A. Comply with General Conditions and Division 1 Section "Product Requirements" using form in Division 1 Section "Substitution Request Form".

2.4 CARRIER DESIGN PARAMETERS

- A. Design Life
1. The design life of the carrier using current standards shall be a minimum of 30 years in the specified environment, with appropriate overhauls. The operating conditions shall be 230,000 one-way ropeway trips per year.
- B. Assigned Carrier Loading and Weights
1. The SYSTEM SUPPLIER shall verify the carrier dead load, initially, through detailed calculations provided as part of the mechanical equipment design submittal. The actual delivered weight of the carrier shall be verified by the SYSTEM SUPPLIER by the use of a load weighing device. The cabin shall provide a capacity for 25 persons considering the requirements of ANSI B77.1-2011 Section 2.1.4.3 with a design passenger weight of 170 pounds. The floor area of each cabin shall be approximately 65 ft².
 2. The weight of an empty cabin fully equipped for passenger service shall be equally balanced from end-to-end and from side-to-side such that the load on each primary suspension member is approximately the same.
- C. Station Platform Edge Interface
1. The carrier shall be designed such that it is in accordance with the system level requirements of the cabin/station interface. In addition, the cabin design shall be compliant with the following requirements for control of vertical floor heights and lateral cabin-to-platform clearance.
 2. When a cabin is stopped in a station, the level cabin floor height shall not vary more than ± 16 mm (5/8 inch) from the station platform finished floor height for loading conditions between empty and fully loaded with 25 persons.
 3. The cabin floor shall remain substantially level under all conditions of load imbalance or shifting during the alighting/boarding process. During the alighting/boarding process, with any combination of alighting/boarding loads, the differential in floor height to station platform height at any point on any door threshold shall not exceed the maximum variation allowed above and any differential in floor height between all open door thresholds shall not exceed 12 mm (1/2 inch) for more than 3 seconds.
 4. Under static conditions (i.e., cabin stopped at a station) the lateral clearance between the cabin at the door threshold and the edge of the platform or bumper molding shall not exceed 25 mm (1 inch).
- D. Structural Design Criteria
1. Thorough documentation of material stress, the fatigue analyses shall be submitted as part of the carrier submittal to the Engineer for review. Materials which have fatigue strengths greater than 80% of yield strength shall not be used for structural members unless by the Engineer's assessment the design has been rigorously performed by knowledgeable engineers and/or it has been adequately proven in similar ropeway applications.
 2. The following defines the structural requirements for the carrier.
 - a. Allowable Material Stresses
The carrier - which includes the suspension/guidance assemblies, structure, body, doors, windows, underframe mounted equipment, interior mounted equipment and interior furnishings - shall be designed with sufficient strength of panels, members, welds, mounting fixtures/devices, fasteners and covers/enclosures to meet the criteria given below. For purposes of these requirements, operating conditions shall include emergency.
 - b. A cabin in normal operation with a maximum operating load shall not have stresses which exceed:
 - 1) 50% of column buckling loads (2.0 Safety Factor) and
 - 2) Structural members and associated welds shall not have fatigue stresses which exceed 66% of fatigue stress limit (1.5 Safety Factor, greater than 10,000,000 cycles) according to industry design standards on material properties;
 - c. Material stresses in the structural members and welds of the carrier frame, body, mounts, carriage and under cabin structural design maximum operating load conditions shall not exceed 80% of yield strength (1.25 Safety Factor) for the following events:
 - 1) End-of-guideway buffer contact of a carrier at 1 m/s,
 - 2) Sudden failure of carriage wheel or axle when traveling at full speed.

- d. Material stresses shall not exceed yield strengths for opposite point diagonal cabin oscillation with contact with guidage.
 - e. The passenger seats, seat frames and body wall structure where the seats attach inside the passenger compartment shall be designed to withstand a 135 kg (300 lbs) load at the front edge of the seat without exceeding 50% of yield strength (2.0 Safety Factor); and
 - f. With a 115 kg (250 lbs) person standing on the roof, the stress of the roof skin and structure shall not exceed 50% of yield strength.
- E. Resonance and Vibration
- 1. The cabin suspension, equipment, equipment mounts, equipment covers/enclosures, body panels and interior furnishings shall be designed in a manner to properly impede resonant response to the fundamental forcing frequencies of the operating cabin motion and the onboard operating equipment motion. Such vibrations and dynamic response described above shall not be imposed on the cabin frame or suspension/guidance assemblies in any manner which compromises the design requirements for fatigue strength of mounting points.

2.5 CARRIAGE

- A. The carriage shall meet the requirements of ANSI B77.1-2011 Section 2.1.4.4. The SYSTEM SUPPLIER shall provide documentation of the testing for the carriage.
- B. The carriage shall have safety tie off points pursuant to the requirements of the Referenced Standards.
- C. The system shall be supplied with track rope brakes in accordance with ANSI B77.1-2011.

2.6 HANGER

- A. The hanger provided shall have been designed considering the fatigue resistance of all materials and connections per the general requirement given above. The design techniques used for the hanger shall predict stress patterns throughout the hanger and its connections to the carriage and cabin. The design loadings shall represent the maximum and minimum required considering the reference standards and the design operating conditions.
- B. Sway dampers or other approved means shall be provided to reduce longitudinal sway of the carrier. In addition to allowing the functional docking of the cabin at the terminals, sway dampers shall be designed to reduce passenger discomfort from an unevenly loaded cabin. Design review of the dampers will consider rotational displacement, speed and acceleration.

2.7 CABIN

- A. The final design scheme of the cabin shall be approved by the OWNER. The design of the cabin shall be based on the design scheme provided in the Drawings. The design schedule for the cabin shall include 30 days for OWNER participation in design development.
- B. The cabins shall be equipped with:
 - 1. Lighting
 - a. The cabin lighting shall provide an average maintained illumination level of 55 lux (5 foot-candles) at the floor level and the lights shall be mounted in the ceiling. Emergency lighting shall provide 22 lux (2 foot-candles) at the floor level.
 - 2. Doors
 - a. A single sliding door shall be provided on the right side (looking uphill) of the uphill half of the cabin. A single sliding door shall also be provided on the left hand side (looking uphill) of the uphill end of the cabin. The cabin doors shall operate automatically in accordance with door control safety and dwell time control requirements of the control system. In manual mode, maintenance personnel shall be able to control door opening and closing using pushbuttons on the manual controller. In stations, a matching platform door shall operate simultaneously with automatic or manually-operated cabin doors provided all door control safety conditions as stated in Related Sections are satisfied.
 - b. When an obstruction is sensed, unless manual operation is selected, during the door closing cycle and prior to the operation of door closed travel limit switches, the respective door, in coordination with the matching station door, shall respond in accordance with the obstruction detection requirements of Related Sections.

3. The minimum door opening shall be 1.9 m (76 inches) high and 1.2 m (47 inches) wide.
 4. The opening shall be equipped or provided with:
 - a. A door panel sliding track assembly with access provisions for inspecting, adjusting and other maintenance;
 - b. A non-skid threshold with door panel lower track and extensions thereof designed to prevent panel rattle and provide for self-cleaning and draining;
 - c. An outside rain drip shield above door;
 - d. A door closed limit switch(es) installed and wired to cut-out the door panel obstruction sensing circuits when the panels close to within 12 mm (1/2 inch) of the fully closed and locked position; and
 - e. A body-mounted weather-strip on each side of door opening.
 5. The door panel shall be insulated and sealed against moisture and sound penetration, finished to match the interior and exterior body finish and equipped or provided with:
 - a. Hanger assembly bottom guides;
 - b. Obstruction sensing devices;
 - c. An actuator complete with power supplies and controls including limit switches, speed controls and provisions for locking shall be supplied. The force necessary to prevent the closing of the door panel, from rest, shall not be more than 135 N (30 lb). The kinetic energy of each door panel at the maximum rate of travel shall not exceed 9.5 J (7.0 lb-ft);
 - d. Provisions shall be provided both inside and outside the cabin to manually unlock and open a door when no power is available to the cabin.
 6. The door panel and its associated hanger and bottom door guide shall be structurally capable of withstanding without deformation a 1100 N (250 lb) force over a 102 mm x 102mm (4 inch x 4 inch) area when applied to the center of the panel at right angles to the plane of the door.
- C. Cabin Control Station
1. Each cabin shall contain a control station that shall provide for the functions as defined in Related Sections.
- D. Cabin Communication
1. The cabin communication systems shall be as specified in related Sections and shall include the following:
 - a. Two CONTRACTOR supplied cameras located inside the cabin, installed by SYSTEM SUPPLIER.
 - b. Call for Assistance Station (CFA).
 - c. Two video monitors capable of displaying video feeds and messages.
- E. Chemical, Biological, Radiological, Nuclear Detector
1. There shall be a chemical, biological, radiological, and nuclear (CBRN) detector installed in the cabin. The CBRN shall be OWNER-supplied and SYSTEM SUPPLIER installed.
- F. Stored Energy
1. Each cabin shall be provided with on board stored energy as required by Related Sections.
- G. Cabin Ventilation System
1. The cabin shall be provided with outdoor roof-top mounted active ventilation appropriate for the environment and passenger comfort. As a minimum, the ventilation shall be activated when the interior cabin air temperature reaches an adjustable set point. At a minimum, the cabin ventilation shall include two ventilation fans rated to a minimum of 500 cfm each. Additional fans and/or additional flow capacity are permitted as recommended by the cabin manufacturer. Operation of all fans simultaneously shall not produce objectionable sounds or sound levels. During simultaneous operation the fans shall not produce a sound level greater than 60dBA in the cabin, measured 48 inches above the floor at the center of the cabin. Further, during simultaneous operation, the fans shall not produce a sound level greater than 65dBA in the cabin, measured 48 inches above the floor directly below any fan.
 2. Each fan unit shall be compliant with the following:
 - a. Unit shall be rated in accordance with ARI Standards 210 or 360.
 - b. Unit shall be designed to conform to ASHRAE 15, latest revision.
 - c. Unit shall be UL-listed.
 - d. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- H. Glazing
1. The windows shall be designed and installed in a manner that enhances safety, comfort and aesthetically pleasing qualities of the cabin interior and body exterior. If the glazing is installed by

adhesives, secondary mechanical retention shall be used to prevent the dislodging of glazing under the loading below.

2. All windows shall be a laminated, non-reflective glass.
 3. As a minimum, the windows shall comprise approximately 80% of the cabin wall area. No operable windows shall be provided. Windows shall be designed and installed in a manner, which minimizes external light glare and visibility of internal light reflections. Mounting of window glazing shall be such that it is reasonably easy to replace and free of rattles and visible flexing during operations. Window frames shall be structurally designed to prevent warping of glazing during operations under maximum cabin structural design load conditions.
 4. The window glazing shall be free of visible distortions and provide resistance to scratching. Window glazing shall be tinted a neutral color which shall be coordinated as part of the cabin color scheme. Window glazing and transmittance shall be approved by the OWNER.
 5. All materials in the window assembly shall be impervious to commercial cleaning detergents and techniques. All window assemblies and glazing shall also meet the requirements of water tightness defined in Cabin Body Leak Tests, below. Furthermore, all window assemblies and glazing shall be designed to withstand the wind loadings specified in related Sections. Additionally, the window and window assembly shall be designed to withstand a force of 400 pounds applied anywhere in the window pane without dislodging or failure.
- I. Load Weighing System
1. The cabin shall have a load weighing system integrated into the control system. When the cabin payload reaches 105% of the design payload, audible and visual alarms shall be triggered at the control station. When the cabin payload reaches 115% of the design payload, audible and visual alarms shall be triggered at the control station and in the cabin and the cabin shall be prevented from leaving the station.
 2. The system shall be accurate to plus or minus 2.0%; provide a display in the cabin control station and in the control center; provide selectable readouts in pounds and kilograms; be operable considering climatic design parameters provided in Related Sections; and provide selectable tare weights and displays in net weight mode.
 3. The system shall provide a function for accumulating loads over a set period of time.
- J. Amenities
1. Elderly and handicapped accommodations, including minimum door opening clearances and wheel chair tie downs shall be provided. Handrails and stanchions shall be sufficient to permit safe boarding/alighting, onboard circulation and standing assistance for elderly and handicapped persons, including those in wheelchairs. Stanchions shall be located so as to not impede wheelchair passage and maneuverability, especially immediately inside doorways.
 2. Fold down seats shall be provided on the downhill end of the cabin. There shall be a minimum of four (4) seats in the cabin.
 3. The cabin shall have public address systems and the control system shall provide the capability for transmitting to the cabin and receiving from the cabin audio information.
- K. Cabin Body Leak Test
1. Each cabin body shall be given a leak test prior to finish painting and the installation of the interior finish. The body shall be subjected to a directly impinging water spray from a distance not greater than three feet normal to the surface. Water pressure shall be not less than 620 KPa (90 psi) with a spray nozzle sized to provide the specified flow rates. All skin surfaces and window molding areas of the body shall be directly sprayed at the rate of $0.025 \text{ m}^3/\text{min}/\text{m}^2$ ($0.6 \text{ gal}/\text{min}/\text{ft}^2$) for 10 minutes while an observer on the inside checks and marks the locations of leaks. After corrective action, the test for the affected areas shall be successively repeated until all leaks are stopped. Door edges and seals shall be tested in a manner similar to the skin surfaces except the water pressure may be reduced to 275 KPa (40 psi) with a spray nozzle sized to provide the specified flow rates.
- L. Safety Tie Off
1. The cabin roof shall have safety tie off points pursuant to the requirements of Reference Standards.

2.7. WIND OPERATING PLAN

- A. The SYSTEM SUPPLIER shall develop and provide a wind operating plan, acceptable to the Engineer and the Authority Having Jurisdiction that provides criteria for degrading the speed or terminating service of the

system depending on the response of the cabins and ropes to the action of the wind. The wind operating plan shall satisfy the requirements of Related Sections.

2.8 HAULING ROPE

- A. There shall be two hauling ropes as shown on the Drawings.
- B. The rope specification used in the reference design is as follows:
 - 1. Lift Name: Park Plaza Gondola
 - 2. Operator: Transbay Tower LLC
 - 3. Lift Type: Single Reversible
 - 4. Rope Description: Haul Rope
 - 5. Diameter, +2%, -0.5%: 0.490"
 - 6. Construction: Armored Wireline Strand; 20 – 0.046 / 20 - 0.062
 - 7. Grade: EIPS
 - 8. Core: 7C – 20 GA. CU Insulated Conductors
 - 9. Lay: Opposed
 - 10. Finish: Galvanized
 - 11. Catalog Breaking Strength: 28,000 LBf
 - 12. Weight Density: 405 LBf/Kft
 - 13. Lubrication: None
 - 14. Maintenance Lubrication: None
 - 15. This strand shall comply with the provisions of ANSI B77.1-2011, Annex A.
 - 16. The rope selected for the reference design is Daecero 490 7DFTK HS.
 - 17. Anchors shall be provided to allow for removal and replacement of either hauling rope.

2.9 SUPPORT ROPES (TRACK ROPES)

- A. Strand
 - 1. The SYSTEM SUPPLIER shall supply two torque-relieved Full lock coil track ropes with preformed (twisted) profile wires as shown on the Drawings.
 - 2. The final design of the strand shall be approved by the SYSTEM SUPPLIER, the strand manufacturer and the Engineer. The ropes shall be designed using current standards to provide a useful life for 750,000 Ropeway trips.
 - 3. Each track strand shall have a magnetic rope inspection (MRT) as defined in ANSI B77.1 – 2011 after installation during the acceptance testing program.
- B. The rope specification used in the reference design is as follows:
 - 1. Lift Name: Park Plaza Gondola
 - 2. Operator: Transbay Tower LLC
 - 3. Lift Type: Single Reversible
 - 4. Rope Description: Track Rope
 - 5. Diameter, +5%, -0%: 32mm (1 ½")
 - 6. Construction: Locked Coil 2; Two Layer Locked Coil Strand
 - 7. Core: Round Wire Strand
 - 8. Minimum Breaking Strength: 1048 KN (235 kLBf)
 - 9. Finish: Galvanized
 - 10. Weight Density: 5.99 kg/M (4.03 LBf/FT)
 - 11. Lubrication: [Per Manufacturer]
 - 12. Maintenance Lubrication: [Per Manufacturer]
 - 13. This strand shall comply with the provisions of ANSI B77.1-2011, Annex A.
- C. Anchorage
 - 1. The SYSTEM SUPPLIER shall furnish all mechanical connections for terminating the support ropes at concrete anchorages. The end connection bending radius shall conform to ANSI B77.1 – 2011, Section 2.1.2.10 and A3.2.5 or to that recommended by the strand supplier supported by testing.
 - 2. Each support rope shall have the means at one anchorage point for adjusting the length and the tension of the support rope. This adjustment shall be adequate for the anticipated life of the strand. The other end of each support rope shall have a connection that conforms to ANSI B77.1 – 2011, Section A3.2.5. If a socket connection is used it shall develop the full strength of the rope; be approved by the strand

- supplier; not by its design induce internal corrosion and have an acceptable inspection and retirement criteria.
3. The system shall be able to sustain two tiers of seismic activity:
 - a. Maximum Earthquake: The system shall withstand a differential movement between the Upper and Lower Terminals of 20" longitudinally and 10" laterally without failure of the equipment. The track rope tension shall not exceed 180 kips per track rope.
 - b. Service Earthquake: The system shall withstand a differential movement between the Upper and Lower Terminals of 6" longitudinally and 4" laterally without damage the equipment. "Without damage to the equipment" means that the system shall be allowed to operate with no additional inspection and no repair.
 4. To accommodate the seismic design criteria, the reference design has incorporated hydraulic devices at the Upper Terminal to allow the release of an additional 6" length of track rope in the event of an over-tension event (See Drawings). The reference design allows for the release of additional track rope in the event that the tension reaches 150% of the design tension without the carrier impacting the facilities at the Upper or Lower Terminals.

2.10 STATION EQUIPMENT

A. Track Rope Supports

1. The SYSTEM SUPPLIER shall furnish all mechanical connections between the track ropes and the concrete foundations. The length along the rope for connecting to the support structure shall be sufficient to support the carrier to meet the requirements of Platform Edge Interface. The radius of the saddle shall provide bending radius no smaller than that provided for at the anchorage, if any, and shall meet the requirements of the strand supplier.
2. The track cable saddles and mounts shall meet the requirements of ANSI B77.1 – 2011 Section 2.1.3.4(a)

B. End of Travel Considerations

1. A buffer shall be furnished for installation at both ends of travel. When impacted, the buffer shall impart a controlled deceleration through mechanical absorption of the kinetic energy of the carrier. The buffers shall be capable of initiating a retarding force sufficient to safely stop a fully loaded carrier from a speed of 1 m/s. The buffers shall produce approximately constant deceleration throughout their allowable travel. The deceleration shall be less than 0.5g.

C. Platform Edge Doors

1. Each terminal docking position shall be enclosed by a glass screen wall. The screen wall shall be interrupted by platform edge doors to provide access to the docked system cabin. The screen wall and its supports shall be furnished and erected by CONTRACTOR. The platform edge doors and their supports shall be designed and furnished by SYSTEM SUPPLIER, erected by CONTRACTOR. Detailed coordination between CONTRACTOR, SYSTEM SUPPLIER and OWNER will be required.
2. A horizontal, unidirectional sliding door shall be provided at each cabin door interface location of each docking position. Platform edge doors shall operate automatically in accordance with door control safety and dwell time control requirements of the control system. Matching platform edge and cabin doors shall operate simultaneously so that all door control safety conditions as stated in Related Sections are satisfied.
3. When an obstruction is sensed, unless manual operation is selected, during the door closing cycle and prior to the operation of door closed travel limit switches, the respective door set shall respond in accordance with the obstruction detection requirements of Related Sections.
4. Platform edge doors shall have an opening larger than the opening of the cabin doors.
5. Each opening shall be equipped or provided with:
 - a. A door panel sliding track assembly with access provisions for inspecting, adjusting and other maintenance;
 - b. A non-skid threshold with door panel lower track and extensions thereof designed to prevent panel rattle and provide for self-cleaning and draining;
 - c. A door closed limit switch(es) installed and wired to cut-out the door panel obstruction sensing circuits when the panels close to within 12 mm (1/2 inch) of the fully closed and locked position; and
 - d. A weather-strip on each side of door opening.
6. Each door panel or set of panels shall be provided for outdoor installation and insulated and sealed against moisture and sound penetration and equipped or provided with:
 - a. Hanger assembly bottom guides;
 - b. Obstruction sensing devices;

- c. An actuator complete with power supplies and controls including limit switches, speed controls and provisions for locking shall be supplied. The force necessary to prevent the closing of the door panel, from rest, shall not be more than 135 N (30 lb). The kinetic energy of each door panel at the maximum rate of travel shall not exceed 9.5 J (7.0 lb-ft);
 7. Each door panel and its associated hangers and bottom door guides shall be structurally capable of withstanding without deformation a 1100 N (250 lb) force over a 102 mm x 102mm (4 inch x 4 inch) area when applied to the center of the panel at right angles to the plane of the door.
 8. Glass in platform edge doors shall comply with the requirements of ASTM C1036-91 (1997), ASTM C1048-97b, ANSI Z7.1-1984 and Code of Federal Regulations, 16 CFR 1201. Markings as specified in ANSI Z97.1 shall be on each separate piece of glass and shall remain visible after installation.
 9. The space between the platform edge doors and the cabin doors shall be designed to prevent door closure when passengers are in the space between the door sets unless the gap is less than 130 mm (5 in.) within the entire space from the platform level up to 1.1 m (42 in.) above the platform level.
- D. Access Plan
1. An access plan that meets the requirements of ANSI B77.1-2011 and applicable Referenced Standards while minimizing permanent platforms and public access, handrails and stairways shall be developed by the SYSTEM SUPPLIER. Based on a plan approved by the OWNER, the SYSTEM SUPPLIER shall provide the necessary assemblies to allow maintenance and operating personnel access to all mechanical and electrical operating equipment including but not limited to terminal control switches and speed control devices; the carriage, track rope terminations (if any); and all shafting, bearings and couplings.
- E. Rigging Points
1. The SYSTEM SUPPLIER shall furnish rigging attachment points in both stations that allow for the installation and removal of the hauling rope and track ropes. Consideration shall be given to anchoring of winching and spooling devices at the stations.
- F. Finishing
1. All steel members shall be hot dipped galvanized with a minimum thickness of 4 mils (2.4 oz/ft²). The galvanization shall be in accordance with ASTM A123-02, "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"; ASTM A384-02, "Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies" and ASTM A385-05, "Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)".
 2. Repairs for damage occurring to surfaces shall be made according to ASTM A780-01, "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings".
 3. Members shall be painted in conformance with Exterior Painting Section 09 91 13 of the project specifications.
- G. Upper Station Deflection Sheaves
1. The deflection sheaves shall be a one-piece fabrication to conform to a standard design of the SYSTEM SUPPLIER that has been proven in service with the design loading. The bearings shall be designed to provide a minimum service life of 2,000,000 one-way trips considering a load service factor of 1.25.
 2. Anchors or anchor points shall be provided on the terminal structure to allow the removal of the hauling rope from the deflection sheaves. The SYSTEM SUPPLIER shall supply any auxiliary equipment required for removing the hauling rope and a written procedure for this removal.
- H. Video Surveillance
1. Cameras with views on the queuing areas and doors will be supplied and installed by CONTRACTOR. Any additional cameras required in station areas shall be furnished by SYSTEM SUPPLIER and installed by CONTRACTOR.

2.11 DRIVE MACHINERY

- A. Winch drive
1. The two hauling ropes shall be accommodated on one drum in a single layer. The drum shall be spirally lagged. The drum weld stresses shall not exceed 4ksi and stresses to the base metal of the drum shall not exceed 10ksi. The flanges of the drum shall provide for braking as specified in the Brakes section below. The drum shall provide for plate clamp termination of the two haul ropes. The drum shall have slip ring connections as specified in Related Sections for 14 conductors. The drum shall have slack rope detection based on

grounding of either of the haul ropes. The winch drum shall be electrically isolated from the drive motor drive shaft using an elastomeric coupling.

- B. Gear Reducer
 - 1. The gear reducer shall be one of proven design for a similar application with a service factor of 1.25 considering the maximum operating torque. Gear fatigue design shall conform to the procedures of the American Gear Manufacturers Association.
 - 2. The gear reducer shall be designed to operate within the manufacturer's thermal and mechanical ratings. If required, the gear reducer shall be supplied with provisions for regulating the temperature of the oil and case.
- C. Electric Motor and Control – Primary Drive
 - 1. For the motor and control specification, reference Related Sections.
- D. Standby Auxiliary Power
 - 1. The standby auxiliary power shall be provided by the OWNER.
 - 2. The standby auxiliary motor shall behave the same rating as the primary motor. The motor shall have an independent connection to the drive trains as shown on the drawings.
- E. Evacuation auxiliary
 - 1. The drive system shall be designed such that the cabin can return by gravity, in a controlled fashion, to the lower station in case of failure of the gearbox or electric motor. Such gravity return shall not require any external power and shall be executable within 30 minutes of a system failure.
- F. Brakes
 - 1. The brakes provided shall include the service and emergency brakes . All braking systems supplied shall have fully redundant capability such that the failure of any component shall not render the system inoperable for more than 10 minutes. Each braking system shall be fully independent including, but not limited to, braking surfaces, piping, reservoirs and control system.
 - 2. The brakes shall be of the caliper type with both acting on the winch drum flanges. Both of these brakes shall be supplied with independent electro-hydraulic or electric power units for retracting the brakes in a reasonable time. The brakes shall have the capability of being released by manual pumps integrally designed into the brake control system.
 - 3. All brakes shall be designed to stop and hold the ropeway operating in the maximum overhauling condition without the aid of the braking friction of the gear reducer and considering the full rotating mass of the drive equipment.
- G. Shafting and Couplings
 - 1. Shafting shall be designed using accepted procedures for fatigue loading and the SYSTEM SUPPLIER's design standards that have been proven in service.
 - 2. Couplings shall be designed to tolerate normal anticipated misalignment and transmit 150% of rated torque.
- H. Access and Guarding
 - 1. SYSTEM SUPPLIER shall provide equipment access and guards conforming to ANSI/ASME B 15.1-2008. Guards shall be provided around all rotating machinery to prevent uncontrolled release of energy upon mechanical failure.

2.12 TOOLS AND MAINTENANCE EQUIPMENT

- 1. The SYSTEM SUPPLIER shall supply the necessary specialty tools to perform the maintenance prescribed in the Maintenance Manual. Upon completion of the installation, the specialty tools shall become the property of the OWNER.

END OF SECTION